THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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ELECTRIC RAILWAY TRACTION.

FEW railway projects have attracted more attention, or excited more discussion, than the bold undertaking of Messrs. Ganz & Co., of Buda-Pest, to equip and operate the Valtellina Railway with three-phase current, supplied to the trains at the pressure of 3,000 volts. This railway, to which frequent reference has been made in our columns, is situated near Lake Como in northern Italy, and was visited by the Institution of Electrical Engineers last year; it forms part of the system of the Adriatic Railway Co., and comprises over 60 miles of route.

Adverse rumours have been heard from time to time as to the working results obtained under the unprecedented conditions of the electrical system; but, nevertheless, the railway has continued in operation for nearly two years, and we now learn that the railway company has taken over the electrical installation from the contractors as from July 10th. The conditions of the contract provided that the transfer should not be carried out unless during a guarantee period of two years the system of traction employed and the whole installation proved entirely successful, both technically and commercially; the fact that the railway company has not waited for the expiry of the guarantee period, which had more than three months still to run at the time of the transfer, can therefore be regarded only as a definite indication that the company is completely satisfied with the working of the railway and the quality of the plant. Thus Messrs. Ganz & Co. are entitled to due credit for their triumphant solution of the numerous difficult problems which were met with in the construction of this unique system, one of the boldest departures from standard lines ever recorded in the annals of electricity.

We may be allowed to point out that in December, 1900, commenting upon Mr. Langdon's I.E.E. paper on the supersession of the steam locomotive, and on other occasions, we maintained that alternate current transmission (without conversion to direct current), overhead working conductors, and high pressures on the latter, were essential features of electric traction on main line railways. At that time three-phase motors alone were available for the purpose, and the success which Messrs. Ganz & Co. have attained with them justifies the confidence of the company, and bears out our contentions. We still uphold our former views, the only modifying circumstance which has arisen in the meantime being the successful development of the single-phase alternating-current motor; this, we need not add, immensely simplifies the problem, and gives the strongest possible support to our expressed opinions.

Turning to our Home railways, it cannot be said that any material progress has been effected during the past half-year towards their conversion to electrical working. There are, no doubt, enormous difficulties to be overcome, and the con-

ditions prevailing in this country are very different from those obtaining in Italy; on the other hand, the differences are in some respects in favour of electrical working, rather than opposed to it. Perhaps the paramount obstacle to progress in this direction is the excessive caution of the directors and shareholders of the respective companies, a feature not always noticeable in the management of their finances, but very tangible when the adoption of technical improvements, or the comfort of passengers, is the question under consideration. This cautious attitude is reflected in the speeches of chairmen at the half-yearly meetings which have been held recently. Several companies are experimenting with motor-coaches, propelled by steam or petrol, to deal with light traffic, and some are even running motor-cars on the public roads. These are inexpensive experiments, and have no particular bearing upon the subject of suburban and interurban electric railways. The important work which has been carried out on the Lancashire and Yorkshire and the North-Eastern Railways, has not yet been completed long enough to furnish results of material interest, save in one direction—namely, in the destruction of life which has followed upon the use of the third-rail system. With the exception of the short length of the Metropolitan District Railway at Harrow, these are, at present, the only inter-urban electric railways in this country, and, therefore, the only railways of this kind to which trespassers have ready access; and the death-roll to date, within the first few months of working, numbers 6 human beings.

The alternative to this third-rail danger, stretching for miles through rural districts, short of shielding it with wooden guards from end to end, is to place the conductor overhead and work at higher pressures. The Board of Trade may insist on the shielding of the third rail, when full reports have been received from their officials, a course not very palatable to the railway companies. Our own opinion is unchanged, that for such railways, no less than for main lines, the overhead conductor will eventually oust the third rail, with immense advantage to all parties.

After all, whilst electrical engineers themselves continue to shiver on the brink, hesitating to depart from the standard third-rail system—because they *know* that will work, but they are not so sure of the overhead A.C. system—can it be wondered at that railway directors also fear to take the plunge? In view of this spectacle, our admiration of the dauntless enterprise of the Hungarian firm of Ganz & Co., gains fresh ardour. Would that our British experts would profit by their example, that of the Union Co., of Berlin, and that of the Westinghouse Co., of America, and shake off the trammels of custom and inertia.

We believe that in some of these undertakings the training of motormen at least is more elaborate, and regular classes are held at which motormen are bound to attend in turn, and may attend as often as they like, in order to hear an engineer discourse on driving, car equipments, and overhead work. Not motormen only, but inspectors have to come to these classes, as it has been found that a proportion of inspectors are promoted to that rank before they have driven a car at all, or before they can be called truly competent. Consequently they know little about cars and their peculiarities, and less about trolley wire sections, and the quickest way to get out of any kind of tangle.

It is expected of every inspector that he shall know not only the ins and outs of a way-bill, a conductor's conscience, and the current time-table, but shall have a little more knowledge than the best motorman of the best methods of dealing with electrical mishaps.

A special class of motor inspectors has been evolved, and every tramway seems to be making use of them. The title is American, and is a very bad fit. Perhaps one day we shall find another. On some systems there may be room for a special power or engineer's overseer, but in most cases the best results will be obtained if every man who is now named a ticket or traffic inspector, is thoroughly trained to perform the whole of the duties now divided between two classes of inspectors. The full inspector, for instance, would check the way in which the motorman handles his controller, without in the least withdrawing his attention from the man who sometimes manipulates his punch to his own advantage. He would be capable of localising faults on cars when commonsense and a little special knowledge is the only testing set available; and he would not sit with folded hands when current goes off his section, or when overhead wires fall around.

One "motor inspector" on a line of many miles and branches is of as little value as one ticket inspector would be. The fact that he is very useful simply points to the greater benefit which would be derived from greater numbers with his knowledge, as the effective area of the most mobile inspector is not very large, when he is concerned chiefly with details.

Of the 33 systems dealt with in this number of the "Circular," none provides for the periodical re-examination of motormen, although one states that an arrangement is to be made in the future by which this will take place biennially. We should say that the desired effect will be obtained if this re-examination, which should be both physical and mental, were to be made in longer periods, say, once every five years. Special cases would have to be treated as usual in special ways.

Training Car-crews.

THE current "Official Circular" of the Tramways and Light Railways' Association contains a further list of tramways which have told the Board of Trade, for the benefit of the New Zealand Government, how they train motormen and conductors. With the exception of the Ayr Corporation Tramways, all the 33 replies came from the associated companies of the B.E.T., and, as one would expect, the procedure of all is alike, and may be best stated in the condensed sentences of the "Circular."

1. Training.	2. Examinations.	3. Periodical examinations.
Application form to be filled in as to previous employment, names of employers, &c. If satisfactory replies are received, applicants are medically examined. Motormen are given books of rules, are put with experienced motorman, and are instructed by motor inspector. After 12 to 14 days' practice they are usually reported as competent. Conductors should be able to read and write and do simple arithmetic. They are placed with experienced conductors.	On completion of training in both cases they are examined by an official, who finally passes them.	None.

Laymen and Electrical Treatment.

A WRITER in the *Lancet* complains of the practice of certain members of the medical profession, of sending patients whom they wish to be treated by some form of electricity or of the X rays either to a layman or to an institution owned and managed by laymen. He says he knows of a large firm of chemists in London making several thousands a year by taking radiograms of patients, in most cases sent by medical men. This practice of the medical profession certainly tends to encourage the electro-medical quack, but it appears that the medical profession have the remedy in their own hands. The medical man who wishes to submit his patients to electrical treatment must either acquire himself the necessary technical knowledge of electricity, or he must superintend the treatment given by an electrical expert. There are a certain number of medical men who have also the necessary electrical knowledge, but it appears to be doubtful whether there are enough to supply the demand. In simple cases, where there is no risk of injury to the patient, we see no more reason for objecting to the layman operating than to a chemist selling a box of patent pills which experience has proved to be harmless.

"ZONE" DYNAMOS AND MOTORS.

By HENRY F. JOEL, A.M.I.C.E.

THE principal features of this invention, which are embodied in a considerable number of patents acquired by the Zone Dynamo and Motor Patents Co., Ltd., from various inventors, consist in the construction of the energising field coils of the dynamos and motors, so that one coil only is required in place of two or more coils, and the design and disposition of that coil directly over the neutral zone of the armature and close to and either parallel with or cutting at a slight angle the armature coils undergoing commutation, to the great advantage of the working and output.

The invention can be readily understood from the diagrams, figs. 1 and 2, which show the changes effected.

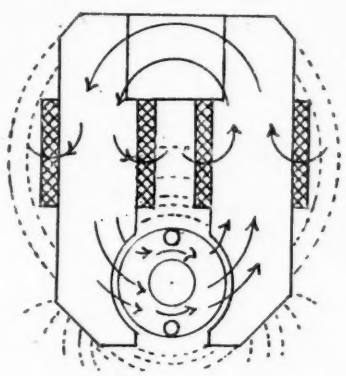


FIG. 1.

Fig. 1 is a diagram of a well-known type of bipolar dynamo, having the usual disposition of the two field coils round the magnet limbs, and the arrows show the direction of the lines of force, whilst the dotted lines indicate the magnetic leakage. In this type the lines of force round the field do not to any extent pass directly through the armature, but first have to pass through the magnet limbs, and then pass through the armature.

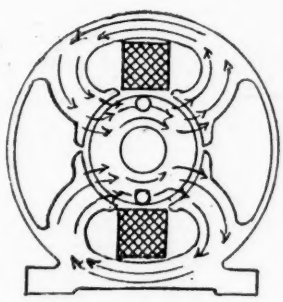


FIG. 2.

Fig. 2 shows the section of the completed and perfected system of a bipolar "Zone" dynamo or motor, in which the magnetic circuit is made as short as possible.

The large upright limbs and yoke are replaced by the circular cast case, and curved bifurcated poles without joints in the magnetic circuit; a single energising coil is placed directly over the neutral zone of the armature, hence the name "Zone." The coil in this position requires less ampere-turns owing to the saving of leakage, than the two coils combined in fig. 1, whilst the output from the armature is found to be greater, and the embracing arc of the poles can be increased, with a lessened reluctance in the air gap, and a considerable reduction in the ampere-turns and saving in the C^2R loss.

The whole machine is smaller, lighter and more efficient. Of far greater importance, however, than even the saving of weight and cost of materials, is the greater efficiency of the zone energising coil.

The contiguity of the coil immediately over and close to the armature coil undergoing commutation, shown by the round O in the diagrams, figs. 1 and 2, has the proved effect of neutralising to a great extent the formation of the current in the short-circuited coil or coils under the brushes at the point of commutation, and thus obviates the disturbance, sparking and heating due to the big currents which would otherwise be created.

The adjacent zone coil in reality forms a closed circuit immediately over the commutating point, and in that position has a transformer choking effect upon the short-circuited armature coil under commutation; each of the armature coils passes in turn under the "zone" coil at the rate of 1,000 to 1,500 times a minute.

This raises, and, in fact, nearly doubles, the usually accepted permissible ampere stream, and the sparking limit is considerably increased, and therefore the output from the armatures of zone dynamos and motors can be rated and pushed higher than is usual, without exceeding the normal sparking and heating limits.

It will be apparent from the foregoing that the single energising coil, combined with a cast magnetic case and poles without tooled joints, and simple circular machine tooling, and the great saving in weight of copper and iron (or steel), enables a considerable reduction to be effected in the cost of manufacture of the zone dynamos and motors, as compared with the usual types; actual examples and figures of machines made and tested show this most convincingly, as well as the greater efficiency and output that are obtained. Briefly, the advantages are:—

1. Less weight.
2. Less leakage.
3. Less ampere-turns C^2R copper loss.
4. Extended pole arc.
5. Increased output with reduced sparking and heating.
6. Single coil, cast frame, circular tooling, cheapness of construction.
7. Improved commutation, allowing the motor to run with fixed brushes, in either direction, without sparking.

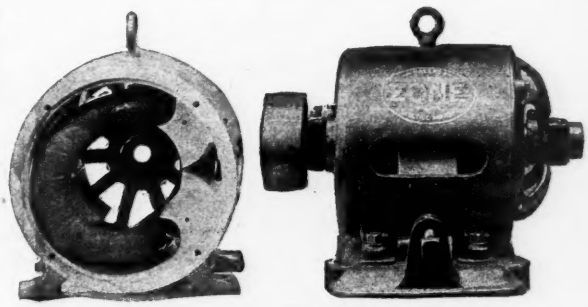


FIG. 3.

Fig. 3 shows reproductions from photographs of a small "zone" bipolar motor, with the iron case and poles shown separately, and the single coil placed in position between the bifurcated poles.

It will be seen from these illustrations how simple this construction really is; there are only four parts, viz., casing with poles, end-bearing, armature, and one field coil. This coil is wound in a former and then placed in position.

For multipolar dynamos and motors, and for motors where extreme lightness, combined with high output, is required, say, for electric cars, launches, &c., a four-pole motor with a single energising coil is made. The longitudinal section, fig. 4, and cross-section, fig. 5, show this special form of zone coil in position relatively to the poles.

The coil is placed in position on one-half of the iron casing, partly embracing, and including the two poles in the magnetising sphere of the coil; the other half of the iron casing, with its two poles, fits the depressions of the coil, and, in turn, is also included in the magnetising sphere of the coil. The one coil magnetises the four poles alternately in two pairs, N,S,N,S. In fig. 6 the coil is shown in section as it would appear if cut through by the line A, B (fig. 4), and the lines of force circle round the coil and magnetise the poles as shown, whilst the zone coil is parallel with, or cuts

D

at a slight angle, the armature winding, and there, as previously explained, magnetises the armature core with the same polarity as is induced by the field poles, and as it is close to the armature coils undergoing commutation, shown in round O, the features and advantages described in reference to the bipolar motor, fig. 2, are identically reproduced and obtained with this coil and four-pole motor, fig. 6, with an even greater saving of weight for output.

Fig. 7 shows a four-pole motor of this type, and in fig. 8 this motor is shown in parts; the divided iron casing, each half of which carries two poles, is shown at the sides

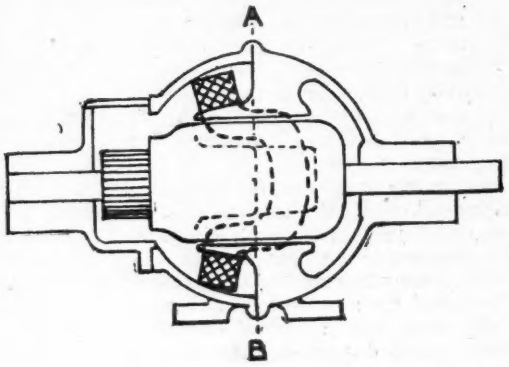
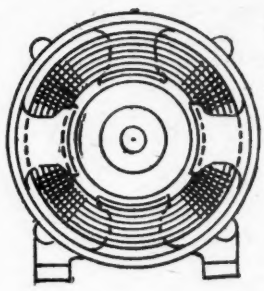


Fig. 4.



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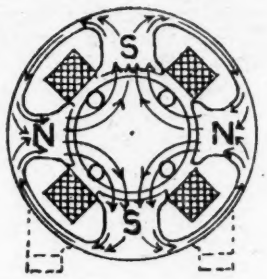

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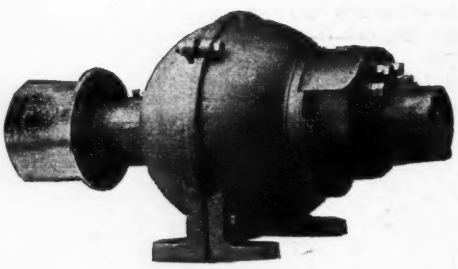


Fig. 7.

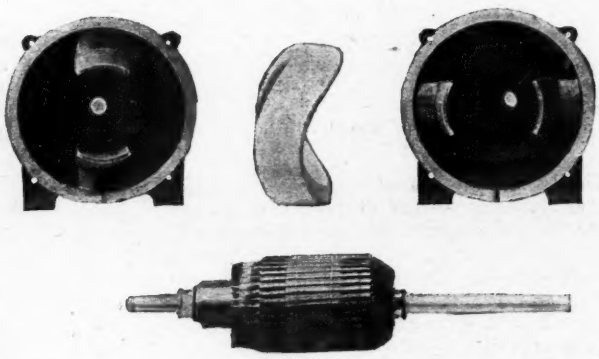


Fig. 8.

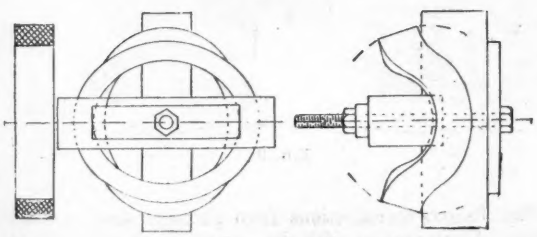


Fig. 9.

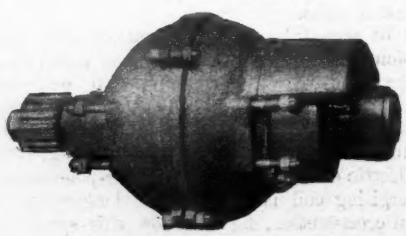


Fig. 10.

with the "zone" coil between the two halves, and the armature underneath.

The zone coil may be wound directly on a ball mould, or spherical former, or alternatively is first wound as a simple ring and afterwards easily and quickly pressed or moulded between two cross timbers, as shown in fig. 9, into the required form, having two curved raised parts. The coil when so shaped becomes spherical in outline, and fits into the hollow hemispheres of the casing carrying the poles.

It is found that this single magnetising coil is of about one-half the weight of the four separate coils ordinarily used in a four-pole motor.

Fig. 10 shows an interesting form of this four-pole motor, specially designed for electric motor cars, launches, &c., and for attaching to machinery. This motor has spherical fields completely enclosed, and can be fixed in any desired position by means of the projecting studs, either to hangers, brackets, or otherwise as may be most convenient.

The weights of the various parts of two sizes of these motors, shown in figs. 7 and 10, are as follows:—

	Fig. 10. 1 to 2-H.P. motor at 1,500 r.p.m.	Fig. 7. 4 to 6-H.P. motor at 1,400 r.p.m.
Cast-steel poles and case	= 38 lbs.	106 lbs.
Field magnet coil, shunt winding	= 6 „	19 „
Bearing, commutator end... ...	= 5½ „	10 „
Armature	= 20½ „	57½ „
Totals	= 70 lbs.	192½ lbs.

(To be concluded.)

CHILLED IRON v. STEEL-TIRED WHEELS.

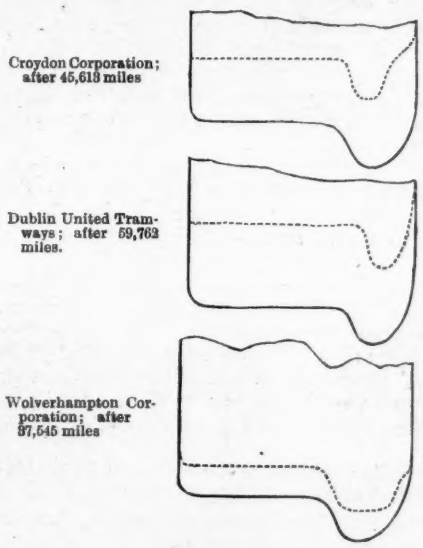
From the fact that the British Griffin Co. have distributed a reprint of our recent articles on this subject, we may assume, with a degree of certainty, that they consider those articles favourable to their particular product. Certainly they ought to be the best judges, so we must accept their opinion. They would be unlikely, at least, to circulate pamphlets adverse to their interests. At the end of the pamphlet appear cuts of three wheel-flange and tread sections representing wheels removed from cars running at Croydon, Dublin, and Wolverhampton. These we produce below, as they afford a striking confirmation of a portion of our previous remarks.

All these wheels have finished their lives, which are very far from uniform. The mean life is 47,600 miles, while the variations from the mean are 4 per cent., 25 per cent., and 21 per cent. Of course, we have no more intention than the British Griffin Co. to present these sections as average specimens. They are admittedly the best available

for the moment, and we are simply examining their characteristics without pretending to put them forward as characteristic of British experience.

The mean life of the three is brought down very obviously by the sample from Wolverhampton. The mean radial wear is ·70 in. (measured approximately from the cuts), and the respective variations from the mean are 7 per cent., 40 per cent., and 46 per cent., while the miles per $\frac{1}{10}$ in. depth of radial wear are 600, 600, and 1,000.

The first two wheels are in a class by themselves, and while we are curious to know the whole of the conditions controlling their performance, we are even more curious to know why the Wolverhampton wheel was removed so early. It is not reasonable to expect many wheels to wear out nearly one inch of tread, or even three-quarters of an


Croydon Corporation; after 45,613 miles
Dublin United Tramways; after 59,762 miles.
Wolverhampton Corporation; after 37,545 miles

Sections of Tread and Flanges, showing Wear, without Re-grinding or any attention (Half-size).

inch, when the chill hardly extends to the latter depth, but the Wolverhampton wheel certainly suffers by comparison, although its life is one which is sought in vain by many a manager.

Whilst the comparison of miles per unit of wear appears to be favourable to the third wheel, this is probably because this figure lessens as the chill is reduced in thickness. Curves showing the mileage value of consecutive units of depth would be instructive; just as the mileages made by these wheels are diverse, so are the final sections. As near as possible the original sections are identical, but not so the forms of the last state.

Looking at these sections, we are so much attracted by the very slight departure from the shape of the first flange on the Dublin wheel, that when this is coupled in our mind with the phenomenal depth of wear, we cannot help asking whether this wheel was a driver or an idler, and whether or no it was subjected to braking, or to the hard use of curves. The combined effect of flange-action and braking, but the former predominantly, is apparent on the Croydon and Wolverhampton wheels—so apparent on the first that one involuntarily asks whether the wheels or the rails were in perfect gauge, or again whether the wheels were set to a theoretically perfect gauge on the so commonly too slender axles, for that concavity at the back of the flange indicates such a state of things.

The British Griffin Co. have writen an interesting letter to us in which they put forward additional arguments, which it is unnecessary to say are either favourable to chilled wheels or unfavourable to steel tires. We should have rejoiced if the leading makers of the steel tire had taken sufficient interest in these articles to have written equally interesting letters from their point of view, for we should have felt then that we had all the salient facts and could deal justly with both disputants.

The British Griffin Co. first expatiate on some of the causes of failure of the cast-wheel which were mentioned in the previous articles, dwelling particularly on the one-time partiality of lighting engineers who had tramways thrust upon them, for wheels of their own designs. "We have in our possession hundreds of such drawings which we can only characterise as appalling." Those days are now almost past, and the British Griffin Co. have found it possible to reduce to two the number of tread and flange designs, finding it better to decline orders for freak designs. We cannot help expressing a certain astonishment that they, as specialists, did not see five years ago what a set-back their business might suffer if they complacently made goods which they must have felt would not advertise themselves for good. They might have understood human nature sufficiently to be aware that an engineer responsible for the design of a wheel would not go out of his way to acknowledge that design defective.

We took objection to figures from Portsmouth, and we are told that the chilled wheels which were in use there in the first place never had a chance. In the first place, the corporation's design was objected to strongly by the manufacturers, and in the second, the corporation insisted upon the wheels being pressed on to the rail gauge, so allowing no play whatever, which would be very fatal to any kind of wheel, but especially to a highly chilled wheel, on the severe curves encountered at Portsmouth. After the first set of flanges had broken off, rather softer chilled wheels to the same design were obtained, with the natural result that the flanges wore better, but the treads were flatted easily. After these ludicrous trials (our correspondents assure us that they can prove every statement) chilled wheels were abandoned for steel-tired wheels, and we presume that they too have been pressed on to rail gauge, for, "within the last few months, some 20 pairs were standing in the car-sheds with the flanges worn away, after having made about 22,000 miles, sufficient tire being left for one turning only."

We are not sorry that we did not accept figures from Portsmouth.

There was once a firm up North which jumped into the chilled wheel business with a wheel sold at something over a sovereign, with a guarantee of 35,000 miles. That firm no longer encourages chilled wheel customers, and the British Griffin Co. legitimately use the incident to point the moral that "there are different qualities of chilled-iron wheels as of everything else," and inferior quality, no doubt, has sent engineers to seek improved results from tires. The company asks why it is possible to obtain an average mileage of 33,500 at Liverpool, while Sheffield obtained only 20,000, and adds that the difference cannot be attributed altogether to local conditions, following it up with the affirmation that, given a free hand, it is confident that the usual guarantee of 30,000 miles can be exceeded under favourable conditions.

What we should like to hear is, that the guarantee will be fulfilled under *average* conditions, including, of course, correct gauging and design.

We admire the way in which the company have faced the fact that steel tires have advantages in particular localities. They inform us that, in such cases, they are actually supplying tired wheels.

Wherever drivers are bad drivers, and wherever flatted wheels are accepted without thought as the unfortunate but unavoidable effect of "putting on the brake suddenly to avoid an accident," there will flats flourish, and the makers of chilled wheels will be cursed to the last generation.

Wherever managers dream of wheels and brakes, the life of any kind of wheel will increase, as Mr. Endean showed in his recent letter, and we do not doubt that such results as 35,000 miles per wheel are obtained only after the minutest attention to essential details, which, we regretfully assert from prolonged experience, are not even realised by many tramway engineers and by more managers.

Our contention that chilled wheels will give far better satisfaction if the brake-blocks are removed or rarely used, is sufficiently obvious, and the tendency is certainly in this direction. Whether the erring tramway world will be regenerated by the application of a slipper of sorts, or by some more gentle means, as indicated in the letter signed by Mr. Endean, we hesitate to prophesy; in any event we are confident that wheel brakes of the "rude mechanical" variety will not trouble us for many years longer.

We shall hope to hear from the makers of steel wheels, and from users with matured experience.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Storage Batteries.

The articles appearing in your issues of July 22nd and 29th, treat very fully, from a manufacturer's point of view, of the care of batteries, but, with the exception of a small paragraph at the end of the article which appeared in your issue of the 22nd inst., no mention is made of the necessity of having a suitable electrolyte.

It is thought sufficient to order "sulphuric acid for storage batteries"—in some instances brimstone-made acid is stipulated—for filling the cells, but my experience, which covers all the different batteries now before the public, convinces me that such specification is not sufficient. Makers of acid will not guarantee the suitability of their acid for use in batteries, because they cannot tell what is the quality of the other material which is used in the construction of the batteries, and any fault that may afterwards appear is at once put down to the acid. In a lot of cases the acid is absolutely unfitted to be used for electrical purposes, in other cases common tap or tank water has been used for breaking down acid that may be otherwise suitable, and very often the materials which are used in constructing the plates, cells, &c., contain impurities, or unsuitable substances, which the acid soon corrodes, and the battery is destroyed.

Sulphuric acid, even when it is the best brimstone made, contains impurities or noxious elements which render it unsuitable for the purpose, unless especially prepared and tested; therefore, if any loss is to be avoided, it falls upon the user of the battery or the supplier of the battery, to analyse everything that, in the form of electrolyte, is used for filling the cells. This means that a staff of efficient chemists have to be kept continually at work, which not only causes expense, but loss of time and money.

This is where the Continental accumulator makers are superior to the English makers, as they not only test everything, but when they find a suitable material, whether it be acid, lead, or the hundred and one things which go to make an accumulator, they only use that article, even if the use of such means that they have to pay more. They have their reputation to make, and they know that unsuitable acid will do more to damage their trade than the matter of pence, if any, saved by using such acid will justify. Such false economy is not for them, and with the exception of a few English makers, who likewise are very particular as to what they use, battery makers will find out when it is too late what a mistake has been made in sacrificing quality to cheapness.

The Continental makers are very particular that the quality of the acid they use is up to a very strict standard which they have laid down, and they will go to the expense and trouble of sending an acid, that passes their specification, over long distances at a great cost for carriage, rather than run the risk of spoiling a battery by using acid that does not come up to their standard of quality. Not so with the English makers; in fact, several of them take the quality of the acid for granted, no matter where they buy it from. Some makers of batteries do not know the difference between pyrites acid, acid made from recovered sulphur, and acid made from the best Sicilian brimstone, to them they are all sulphuric acid and are all suitable. There can be no greater mistake, as the acid must be made from the best Sicilian brimstone, diluted with distilled water, and especially prepared and tested for electrical use. There is such acid made, and even if it does cost more than the ordinary sulphuric acid, which is doubtful, such outlay is fully justified, as where pence may be spent, tens of pounds may be saved.

What applies to accumulator makers, equally applies to the users of the batteries, and where batteries are bought outright, the quality of the acid should be stipulated for. By adopting such methods, makers will find that the maintenance of batteries is considerably reduced, and users will find that their batteries not only last longer but give greater satisfaction, and there will not be the complaints, and the constant changes which now so frequently occur.

J. Kershaw.

London, E.C., *July 29th*, 1904.

City and Guilds Preliminary Examination.

There appears to me to be serious ground for complaint on the part of both students and teachers in the paper set by the City and Guilds examiners last April, in Subject 39 (Electric Light and Power Transmission) Preliminary Grade.

In common, probably, with most other teachers, the writer has regarded this examination as a general grounding for further study of electrical engineering, with several questions inserted relating to practical work for the purposes of the practical examination in wireman's work.

It therefore came as rather a shock to find that no less than eight of the questions related to the last clause in the syllabus, while the other nine clauses were represented by six questions.

It is certainly not fair that teachers who have worked through the whole syllabus, and have tried to thoroughly prepare their students for an examination paper representative of it, should have all their work wasted by such a paper.

A course of about six lectures on practical wiring, completely ignoring all but the last clause, would have resulted in a pass percentage of about 95.

This is not right. It is as though a medical student, after six years' general study, had a final paper in which there were enough questions set in, say, Materia Medica, to enable him to pass without touching upon any other branch of the subject.

It is really very hard to know what to do in this subject. Unlike most others, in which the preliminary and ordinary grades appear to be for helping and improving the *workman*, the Subject 39 syllabus seems from the first only intended for more or less embryo chief engineers, managers, or possibly town councillors, and not in any great degree for the apprentices and working men who form so large a proportion of the students in our various technical school evening classes.

I do not at all object to the paper itself, as it certainly tends in the right direction, but it is not a fair paper to be founded on the course of study prescribed. Is it not possible to have a paper set which will really test the practical knowledge of the students, giving questions which may actually arise during their daily labours, not those which may, only possibly, occur when they are at least in charge of their departments or of some very large job? Under present conditions, if one gives the students instruction in practical matters likely to be of *use* to them, the result of the examinations will be unsatisfactory, while if one sticks to the syllabus, one may find that the paper set deals almost entirely with work of as practical a nature as will occur to the mind of men who have to put a blown fuse or a short circuit in inverted commas.

I have not yet seen the examination results of my own 70 students, but I have qualms, as I most carelessly omitted to coach them in the question (perennial) of the familiar two-way switch, which has certainly earned a rest for a year or two.

Trusting that something may be done to avoid the present waste of time and money.

Wood B. Successful, *Instructor.*

[We sympathise with our correspondent in his difficulties, and agree with him that the paper in question contains questions considerably over the heads of "wiremen;" but it is also a "preliminary" examination in Electric Lighting and Power Transmission, and out of the 14 questions, of which 8 may be attempted, Nos. 1, 6, 8, 10, 12 and 13 ought to be readily answered by any intelligent wireman, involving no calculation. These would easily secure a pass, if only fairly well answered. There are, perhaps, too many

calculation questions—more than one-third of the total—seeing that the syllabus emphasises repeatedly the "descriptive" character of the course; but the sections of the syllabus appear to us to be fairly well represented. Thus, Sec. 1 covers questions Nos. 2, 5 and 11; Sec. 2, No. 6; Secs. 3 and 5, No. 13; Sec. 4, No. 14; Sec. 6, No. 12; Sec. 7, Nos. 7 and 9; Sec. 8, No. 2; Sec. 9, No. 4; and Sec. 10, Nos. 1, 3, 8, 10 and 11. The last certainly seems overburdened.

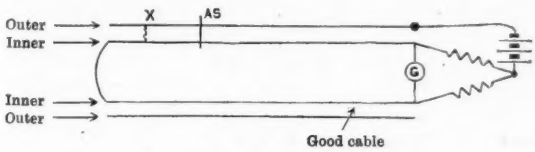
Why the value of the questions is so carefully graded from 30 to 40 marks it is impossible to conceive.—EDS. E.R.]

Localisation of Earths.

In answer to Mr. G. C. Knight's query *re* shorting a cable to assist in finding a short or earth, I beg to state that I used a similar method at Newport in 1900 in localising shorts on concentric cable. My method was:—

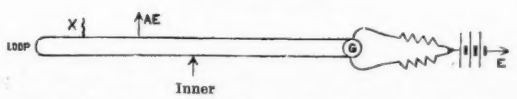
1. Localise from test pit by Murray's loop test (Mr. Boot's fig. 2).
2. Short cable at nearest accessible point on test-pit side of spot localised.
3. Localise again.

Then, as the resistance of the fault would probably be high compared to the artificial short, the difference between the two spots localised would be the distance of the fault from the artificial short.



X, Fault; A S, Artificial short.

LOCALISING SHORT.



X, Earth on outer; A E, Artificial earth on outer (or return lead preferably). Instruments used: Sensitive galvanometer, small 100-v. testing battery, Post Office pattern bridge.

LOCALISING EARTH ON OUTER.

The advantage of this method is that it minimises the liability to errors due to bad jointing, differences in the size of the cable and difficulty in getting at the length of a long-buried cable.

I may say that I had another good cable available to complete the loop, which was 4,000 yards long and of mixed sizes, and got extremely satisfactory results, although I used the test Mr. Boot condemns. Of course, with an earth on the *outer* only, the *inner* would complete the loop, and instead of shorting the cable as at (2) above, I should earth it.

Also if the resistance of the fault is high, a little juice judiciously applied soon improves matters.

A. J. Howard.

Leicester, *August 1st*, 1904.

Having had a fault "up my sleeve" for some days on an important multi-core cable, I determined to take it in hand on the Bank Holiday. It might interest your readers and Mr. Boot to hear the results. After having carefully localised the fault by my own method, I tried method No. 2, as given by Mr. Boot, which gave the fault as 640 yards from testing point. The actual spot was 694 yards, so that, on that test, there was an error of 54 yards. I wished to try method No. 1, but as the multi-core had a resistance of over 20 ohms, I could not manage to "rig" up a slide wire bridge of 40 or 50 ohms, which I considered necessary for that test.

That is a point I could not follow in Mr. Boot's article, as he recommends a slide wire of about ·5 ohm. With such a low resistance as this, the larger percentage of current must pass round the slide wire, and not through the earth at all, which would altogether spoil the test. I should be glad to hear how this is rectified.

I might add I opened out at 694 yards, as indicated by my own test, and found the fault about 2 ft. further on.

Non-Holiday Maker.

August 2nd, 1904.

STREET LIGHTING ON THE CONTINENT.—A correspondent wishes to know whether any of the Continental or Colonial towns adopt the system of combining arc and incandescent lamps for street lighting (arcs till midnight and incandescents after midnight) which is so common in this country.

REVIEWS.

A Handbook of the Electrical Laboratory and Testing Room. By J. A. FLEMING, M.A., D.Sc., F.R.S. Vol. II. London: The *Electrician* Printing and Publishing Co. 1903. Price 14s. net.

Two years ago Prof. Fleming published the first volume of his "Handbook for the Electrical Laboratory and Testing Room," of which the present volume of over 600 pages forms the second half. The five chapters into which it is divided deal respectively with:—(1) The Measurement of Quantity and Energy; (2) The Measurement of Capacity and Inductance; (3) Photometry; (4) Magnetic and Iron Testing; and (5) Dynamo, Motor, and Transformer Testing.

The book is well printed and illustrated. We shall not occupy space here with a list of the minor misprints and inaccuracies we have found in its perusal. These will be duly notified to the author.

It by no means follows because a writer is a great authority on a particular subject, that his book dealing with it should specially excel in that direction, but, apart from its other excellencies, the book is worth purchasing for the sake of the chapter on photometry alone, a branch of work in which Dr. Fleming's name is specially prominent, and in which no handy reference work exists in English dealing with the subject as completely as the manual before us.

If we have a general fault to find, it is that the book is too much a summary, a mere compilation, describing methods and giving references, whereas from so eminent an authority as Dr. Fleming, with his wide experience on so many of the matters dealt with, we should have liked not merely a mention of the *possible* ways of carrying out a given measurement, but some guidance as to the *best* method to employ in a particular case, together with more detailed information as to the accuracy attainable in a particular test.

For example, we find that in the chapter on the measurement of capacity and inductance, which covers more than 100 pages, there is nothing to show whether 1 per cent. or ·01 per cent. is the kind of accuracy with which Dr. Fleming would be content. With an old-fashioned paraffined paper condenser probably the earlier figure is nearer the mark, but we should have liked to find from the book how nearly the latter figure can be approached, when employing the best methods and refined apparatus, such as the perfected rotating commutator of Dr. Fleming and Mr. Clinton, shown before the Physical Society last session, which is here described in detail. When speaking of capacity measurements, we note that no mention is made of the wonderful silvered mica condensers, which seem still to be the speciality of one firm, but whose marvellously high capacity and freedom from absorption, coupled with their abnormally small dimensions and ability to stand high voltage, render them exceptionally suitable for work with alternating currents.

The account of the various commercial forms of energy meter given in the opening pages is very complete and well illustrated. In the latest form of Bastian meter, an older type of which is shown on page 35, the platinum electrodes are replaced by nickel, and the dilute sulphuric acid by potash or soda solution.

We wonder what subtle truth underlies the insertion of the word "about" in the sentence on page 14, "The third of a microfarad charged with 3 volts will hold *about* 1 microcoulomb."

In the chapter on photometry, special attention is given to the photometry of arc and incandescent lamps, and the variation of the candle-power of the latter with time. It is interesting to remember that it was in connection with the measurement of the power used in incandescent lamps that Dr. Fleming, 15 years ago, devised the direct-reading potentiometer, set by a standard cell, which in its present refined form is regarded by the electrical engineer as his ultimate court of appeal, when his ammeters or voltmeters disagree, or need restandardising.

Among the most promising of the proposed standards of light is one suggested by Mr. Petavel, which should have been mentioned in Dr. Fleming's book. It depends on the radiation given out by a definite portion of an electrically-heated metal strip, raised to such a temperature that the energy of the radiation in two selected wave lengths—one in the *infra*-red, the other in the visible spectrum—is equal. This equality can only take place at one sharply defined temperature, and if it can be shown that the coefficient of emissivity of the strip remains unaltered, the simplicity of this form of standard, as compared with some others proposed, has much to recommend it. The opinion of Mr. Petavel, who is probably the only investigator who has worked both with the standards proposed by M. Violle and by the Reichsanstalt, in this matter carries special weight.

In the light of Dr. Fleming's statements as to the "Purkinje" effect (pp. 297 and 333 to 335), it will be interesting to see how further investigation bears out the statements made at a recent meeting of the Physical Society, where Messrs. Simmance and Abady, describing their ingenious new photometer, stated that for such distances as are usually employed in photometric measurements, *there is no such thing as the Purkinje effect*, though no definite figures were given in their paper to support this conclusion.

It may be of interest to note that a set of Dr. Fleming's large bulb incandescent standard lamps are at present under investigation in the newly established photometric department of the National Physical Laboratory, where, in addition to the photometric equipment proper, there have been fitted specially devised arrangements for keeping constant for considerable periods, and accurately measuring, the electric power supplied to the lamps. Dr. Vernon Harcourt's 10-candle pentane lamp is also under investigation.

The chapter on magnetic and iron testing is thoroughly up to date, the permeameters of Messrs. Lamb & Walker and of Mr. Drysdale being both described in detail. One cannot help feeling, however, that this part of the book bears a strong, if somewhat inevitable, resemblance to a standard treatise on the same subject, though we are glad to see that some new figures and data are substituted for some old friends which have done duty in the text-books for a long time.

The index might with advantage have been fuller, but, on the contrary, the lists of references given are unusually complete, and are tabulated in each division in chronological order. In conclusion, we may say that considering the large demands the writing of a book of this kind makes on the time of a busy man like Dr. Fleming, we think, on the whole, the work is well done, and that the result is a book which will undoubtedly be of the greatest possible use for those for whom it is intended.—J. A. H.

The Localisation of Faults on Electric Light Mains. By F. C. Raphael. New edition. London: The *Electrician* Printing and Publishing Co. 1903. Price 7s. 6d. net.

Although more attention has of late been paid to the best methods of maintaining a network of underground mains in good working order, yet there are still a number of undertakings where the station plant gets all the engineer's attention, and the mains are left to look after themselves until something happens; and in such cases it will generally be found that when a fault does occur, the engineer has very little idea of how to localise it. We are, therefore, glad to see this second edition of a very useful book, and can confidently recommend it as well worth careful study on the part of all engineers who have anything to do with electric mains.

After an introductory chapter dealing with the theory of the Wheatstone bridge, loop tests, and the direct deflection method of measuring insulation resistance, and discussing various types of galvanometers and portable testing sets, the author describes a number of methods of measuring the fault resistance of a live network. The methods of testing low pressure direct current networks with voltmeters and ammeters are fully described, and the voltmeter methods are recommended for use on high pressure direct current mains provided that due precautions are taken to avoid accidental contact with the mains. The difficulty of applying these tests to alternating current circuits, due to capacity currents, is pointed out, and several methods are suggested for measuring the voltage of each main daily, and of judging by a comparison of these daily readings whether any change in the insulation is taking place. An interesting method of measuring the fault resistance of an alternating current network by means of superimposed direct currents is described; and we would specially direct the attention of engineers of alternating current systems to it, as it has been in daily use for some years on the 2,000-volt single-phase circuits of the Electra Co. of Amsterdam. The formula which is given for determining the fault resistance by this method is, however, incorrectly stated, as it should be $F = r\frac{d_2}{d_1} - r$, instead of $F = \frac{d_2}{d_1} - r$.

We notice that a bridge method of measuring the fault resistance which was described in the first edition is now omitted, probably because of its complication; and we are glad to see that no mention is made in this second edition of the various so-called direct reading leakage indicators, as the readings given by them are most misleading. A fall of potential method of testing the insulation of live feeders, proposed by Dr. Kallmann, is described; but we do not see how it can give reliable results, as it depends on the measurement of the difference between the current flowing through the feeder at the station end and that flowing into the network at the feeding point; and this difference must be such a small percentage of the current flowing in the feeder as to render accuracy almost impossible, unless the feeder is so faulty as to make it quite unnecessary to determine its actual fault resistance.

Proceeding to deal with the actual localisation of a fault, the author describes Murray's and Varley's loop tests, and points out the great importance of the resistance of contacts as affecting the accuracy of the results. Some useful hints are given as to the best way of connecting the galvanometer in circuit under different conditions of test, and the question of whether the leads should be included in the cable loop or in the resistance arms of the bridge is dealt with more fully than in the first edition. Alternative methods of localising a fault by fall of potential are also described, and these are followed by a chapter on induction methods of localisation by means of a search coil and galvanometer or telephone, with a discussion of the various cases in which these methods may or may not be expected to give good results. Whilst these methods appear to be used a good deal on the Continent and in the United States, they have not, we believe, met with much favour in this country, and it would be interesting to know whether this is due to their not being tried or to their having been tried and found unsatisfactory.

Cases where no return wire is available for the localisation test are next dealt with, and a fall of potential method with two galvanometers is suggested, or alternatively the overlap method, in which the resistance between each end of the cable and earth is measured, or Blavier's method, in which the resistance between one end of the cable and earth is measured, first with the far end free, and then with it well connected to earth; but these tests should only be used as a last resource with cables of low resistance, as the result of a small variation of the fault resistance during test is a considerable error in the apparent position of the fault.

The next chapter deals generally with the application of the tests already described, and it is pointed out that, when the existence of a fault is shown by the daily tests

of the network, it is sometimes possible to get an indication of its position by observation of the feeder ammeters, feeding point voltmeters, or by the blowing of a fuse leaving consumers without current; but that, when these indications are not sufficient, resort must be had to dividing up the network into two or more parts fed by separate feeders, and transferring sections, one at a time, from one part to the other. This is a tedious process on a large network, and we would certainly recommend the use of a special search coil applied to the feeders in the station, as, with it, the part of the network where the fault is can be found, and the work of dividing up is restricted to a much smaller area. When the fault is localised to a certain section of cable, we quite agree with the author that, for the final localisation test, it is generally best to at once disconnect the faulty cable, and make a loop test, rather than attempt to localise the fault by any method that can be applied to a live main, as these latter are too uncertain, and frequently result only in a waste of time. There is one point which is hardly enough insisted upon, viz., that, as a loop test indicates the position of the resultant fault, it is absolutely necessary, to ensure success, that all faults should be repaired as soon as they occur, as, if small faults are left unattended to, their presence may make it very difficult to accurately localise a bad one when it occurs.

A good description of the fault-signalling network used in Berlin is given, as also of a system used by Dr. Probst on the high-pressure single-phase circuits in Vienna; and in the last chapter the algebraic proofs of a number of the formulæ given in the book are collected—a plan which is much to be commended, as many of the readers of a book such as this are quite willing to take the formulæ without bothering about the proof, and an undue amount of mathematics in the text is apt to make them put the book on one side as unreadable.

We are glad to see that the index, always a very important part of any book of reference, is fuller, and more carefully compiled than in the first edition; and, as the book is well written and printed, we are sure that it will be found a valuable addition to the library of the electrical engineer.

PARLIAMENTARY.

Stretford Tramways.

The Bill promoted by the Stretford U.D.C. in this session of Parliament came before the Police and Sanitary Committee of the House of Commons on Thursday last week. The Bill contained a number of tramway proposals, principally extensions of the existing lines, all of them being within the parish and urban district of Stretford.

Tramway No. 1 was a double line commencing by a junction with Tramway No. 5 in Warwick Road and terminating by a junction with the Stretford tramway in Talbot Road. The line was about ½ mile in length.

Tramway No. 2, a double line, commenced by a junction with the Manchester and District Tramways in Upper Chorlton Road terminating by a junction with No. 1 in the Talbot Road.

Tramways Nos. 3, 4, 5, 6 and 7 were all short lengths of double line, and the remaining lines were connecting links between the various lines, with the exception of No. 8, which was a line ½ mile in length along the Derbyshire Road joining the Stretford tramways in Chester Road. The lines were all to be constructed for electric traction.

The preamble of the Bill, so far as the tramways were concerned, was found proved.

Bristol Tramways Extensions.

This Bill, promoted by the Bristol Tramways and Carriage Co., Ltd., came before the Unopposed Bills Committee of the House of Commons on Thursday last week. The main object of the Bill is the extension of the existing tramway system in the City, but the promoters sought also to acquire lands for the purpose of street widenings.

Formal evidence was given and the Committee declared the preamble proved.

Private Bills.—In the House of Commons on July 28th the Lords' amendments to the London United Tramways Bill were agreed with.

In the House of Lords on Tuesday the Electric Lighting (London) Bill was read a second time. In the Commons the following Bills were read a third time:—Manchester Corporation Tramways, North Wales Electric Power, North Riding Tramways and Glasgow Corporation (Tramways, &c.) Order Confirmation.

On Monday in the Lords the L.C.C. (Tramways and Improvements) Bill was read a third time and passed.

Tyneside Tramways and Tramroads Bill.—In the Commons on July 28th the Tyneside Tramways and Tramroads Bill was again considered, and Sir E. Strachey moved an amendment to clause 18 (exercise of running powers not to enhance value of company's tramways on purchase by local authorities) providing that the arbitrator should not have regard to any increase of value directly "due to the use by the company of the tramways of the corporation under the agreement scheduled to the Act, or any modification of such agreement." The amendment was agreed to, and the Bill was ordered to be read a third time.

Royal Assent.—The Royal Assent has been given to the Metropolitan District Railway, and the Bournemouth Corporation (Tramways) Acts.

LEGAL.

Barnes *v.* The Isle of Thanet Electric Tramways and Lighting Co., Ltd.

This case came before Mr. Justice Bray and a common jury in the King's Bench Division on July 27th. It was a claim by Miss Hilda Barnes for damage for personal injuries caused, as she alleged, through the negligence of the company's servants. The defendants admitted liability, and the only question was the amount of compensation to which plaintiff was entitled.

Plaintiff was with her married sister, Mrs. Arnold, riding on one of the defendants' electric cars at Ramsgate on August 12th, 1903. While coming down hill it was said that the driver lost his head and consequently the control of the vehicle, with the result that instead of stopping to allow another car to pass he dashed into it. People were thrown about in the car, and some off the top, and plaintiff and her sister, Mrs. Arnold, were injured. Plaintiff was bruised and sustained severe nervous shock, while her sister was more seriously injured.

The jury returned a verdict for the plaintiff for £75.

Mrs. Arnold claimed compensation in a second action, but this was settled between the parties, the terms not being disclosed.

Jaeger Bros. *v.* Electrical Fittings Co.

In the King's Bench Division on Saturday, Mr. Justice Lawrence heard an action brought by Jaeger Bros. to recover from the Electrical Fittings Co. the sum of £81 3s. 5d. for electrical fittings sold and delivered by the plaintiffs to the defendants between March 23rd and May 3rd last.

The only defence raised was that the period of credit had not expired.

The plaintiffs contended that the goods were sold on the terms of "2½ per cent. discount, prompt monthly cash," while the defendant company declared that they had the option of accepting those terms or of paying "net at three months."

After hearing the evidence, his Lordship found for the plaintiffs, and judgement was accordingly entered for them for the amount claimed with costs.

Electric Slot Meters.

At Hebburn on 25th ult. two lads were charged with having stolen money from electric slot meters, the property of the Northern Counties Electric Supply Co. One of them who had been imprisoned for a similar offence, was sent to gaol for three months, and the other was remanded, to be sent to a reformatory. It was alleged that the defendants entered unoccupied houses and extracted 1s. 4d. from one meter and 1d. from another. The chairman intimated to a representative of the company that the magistrates considered that money should not be left in slot meters in unoccupied houses as long as two months. Boys knew the money was there, and it became a temptation to them.

THE BATCHELLER PNEUMATIC TUBE SYSTEM.

Since the days when Napoleon unsuccessfully planned a descent on these islands, its inhabitants have grown accustomed to invasions, projected and carried out, although it is satisfactory to note that these are usually of the commercial variety, and often as is the case with the Batcheller Co., of American origin, are intended for the benefit of both invaders and invaded.

Londoners are fairly well acquainted with the advantages and disadvantages attaching to human transit in tubes, but however mixed the feelings with which they regard that mode of travel for the individual, it is unlikely that they would experience any-

thing but satisfaction were a successful pneumatic tube network for the dispatch of moderately-sized parcels to be inaugurated.

To establish such a system in the metropolis is the object of the Batcheller syndicate, which has installed some 800 ft. of 8 in. tube, together with the receiving and sending apparatus, at Ranelagh Lodge, Fulham, for the purpose of demonstrating its abilities.

The arrangements adopted are scarcely comparable with the pneumatic dispatch lines inaugurated in 1863 and 1865, when, it will be recalled, circular tubes of considerable size were employed, containing rails on which ran the carriers. The driving power was obtained by exhausting the air from one end of the tubes, and although from its construction somewhat inefficient, the experiment showed the utility of such an arrangement. In the Batcheller system compressed air supplies the motive power, a continuous and uninterrupted current of air flowing through the tube system between the different stations.

The carriers consist of thin sheet-steel cartridges provided with two bearing rings of specially prepared woven cotton fabric, which fit the tube closely.

The carrier is closed at one end and provided at the other with a hinged lid, arranged so that it cannot open inside the tube. Various ingenious apparatus have been designed for the purpose of transmitting and receiving the carriers at the various stations, although we gathered that in practice the "human" machine had proved equally if not more efficient than the special apparatus, at junctions and intermediate stations where it was necessary to select carriers for certain destinations.

The transmitter, situated at the end of the line, consists of a pneumatically-controlled cradle or rocker, into which the carriers are inserted, and which moves the latter into line with the tube at suitable intervals, which are predetermined to allow sufficient headway between the carriers. The receivers for use at distant stations are known as closed receivers, being provided with dead ends into which by their own momentum the carriers pass, incidentally compressing the air in front. This compressed air is utilised for revolving the dead end and carrier into a suitable position for the discharge of the latter.

The receivers for use at near stations are known as open receivers, and in operation the moving carrier forces open a sluice valve, by means of the cushion of compressed air in front, and is discharged into an open receiving trough.

The receivers for use at intermediate stations are far more complicated in construction than the above; in operation, they select by means of special disks attached to the carriers, the carrier destined for a particular station, and discharge it there; if, however, the carrier is destined to pass through the station, the apparatus drops it into the main tube again where it is carried forward in the usual way.

The intermediate stations can be permanently cut out of the main tube by means of an electro-pneumatic street switch.

The carriers shown at Ranelagh Lodge are some 24 in. long, and have a capacity of 800 cb. in.; these negotiate corners having a radius of 8 ft., and the time taken in making the circuit of 800 ft. was some 25 sec, with an air pressure of less than 1 lb. per sq. in.

We gathered that the London scheme involves, in the first instance, an installation of some 95 miles of double 12-in. tubing, this diameter being proved capable of carrying 82 per cent. of the London parcels traffic, and a Bill is to be promoted in the next session of Parliament which involves the employment of some £3,000,000 capital.

THE ADAPTABILITY OF ELECTRICAL DRIVING.*

By B. LONGBOTTOM.

The chief item which contributed to the success of electrical driving, in the first instance, was not so much the efficiency of this method of power distribution as its extreme flexibility. It was early recognised that in works scattered over an extensive area, such as shipbuilding yards, ironworks, collieries, &c., the advantage of electrical distribution over that of any other form was very great, owing to the ease and convenience with which the power could be transmitted.

As the extreme elasticity of this method of distribution asserted itself, it became imperative that the electrical engineer should demonstrate its efficiency as compared with the other methods of power distribution. It is my intention to show, by means of examples, what efficiencies can reasonably be expected, and to compare the results with actual tests of mechanical distribution.

The following table has been compiled from tests I have taken in various well-known works. The figures were arrived at by taking the average of a number of indications of the engine when working on load, and again, with the belts running on the loose pulleys. The difference between the two readings gives the effective horse-power utilised to drive the machinery. Owing to the fact that works have to be arranged to suit the specific nature of the manufacturers, there is bound to be a difference in the variety and number of machines, necessitating a difference in the number of shafts, countershafts, bearings, &c., with the result that no two cases test alike.

* Abstract of paper read before the Manchester Association of Engineers, March 26th, 1904.

Table I.—Tests of Mechanical Distribution.

A.—Details of Plant.

Test No.	Nature of work.	No. of machine tools.	Total length line shafts. Feet.	Diameter of line shafts. Inches.	Average r.p.m of line shafts.	No. of line shaft bearings.	No. of belts.	No. of countershafts.
1	Gas engine makers.	31	303	2·5 and 2·75	196	34	43	19
2	Do.	57	380	2·5 and 2·75	160	44	75	45
3	Do.	79	494	2·5 and 3	150	48	114	72
4	Textile mach. makers	154	546	5in. to 2in. by steps of ½ in.	176	72	210	88
5	Do.	312	1,020	4in. to 2in. by steps of ¼ in.	130	141	432	275
6	Do.	910	2,130	5in. to 2in. by steps of ¼ in.	120	280	1,230	489
7	Cotton mill.	50,000 spindles, spinning American cotton, average counts, 30s twists.						

B.—Details of Test.

Test No.	Average I.H.P. on load.	Effective B.H.P. delivered to machines.	H.P. absorbed by engine, shafting, &c.	Effective power per cent.	Nature of load.	Prime mover.	Working load.
1	29·6	15·1	14·5	51	Steady	Gas	¾ load.
2	18·5	9·3	9·2	50	,,	,,	½ ,,
3	28·8	14·3	14·5	49·7	,,	,,	¼ ,,
4	104	54	50	52	Variable	Steam	Full ,,
5	172	100	72	58	,,	,,	,, ,,
6	506	253	253	50	,,	,,	Over full load.
7	900	630	220	75·5	Steady	,,	About ,,

In the above tests, it was assumed that the frictional losses were constant at all loads, and this is near enough for all practical purposes. In deciding as a basis for comparison that an average of 55 per cent. of the indicated horse-power is effectively delivered to the machines, it will be seen that I have taken a higher figure than the average results of the above tests, which, by the way, are more favourable than many that have been cited in the past.

Turning to electrical distribution, the following table gives the combined efficiency of a range of direct coupled steam-engines and dynamos, from which can be obtained the efficiency of any size of plant ranging from 25 to 1,000 H.P. This table has been compiled, as far as the engine efficiencies are concerned, from data supplied by one of our leading high-speed engine builders, and is the result of repeated tests. The dynamo efficiencies are based upon results that are daily obtained in the test rooms of our leading manufacturers.

Table II.—Efficiencies of Combined High-speed Steam Engines and Dynamos.

Size.			Engine efficiency.			Dynamo efficiency.			Combined efficiency.		
I.H.P.	Engine.	R.P.M.	Load. Full	¾	½	Load. Full	¾	½	Load. Full	¾	½
25	Compound	500	92	90	86	87	85	80	80	76½	69
50	,,	700	93	91	87	89	88	84	83	80	73
100	,,	550	92½	90½	86	91	90	87	84	81½	75
250	,,	500	93	91	87	93	92	89	86½	83½	77½
500	,,	375	93	91	87	94	93	92	87½	84½	80
1,000	,,	250	92½	90½	86	95	94	93	88	85	80
1,000	Triple expansion.	300	91	89	84	95	94	93	86½	83½	78

We will take as our example a plant requiring 100 I.H.P. at ¾-load, equivalent to 133 I.H.P. at full load, and from the table we decide on an efficiency of 82 per cent., so we may take it that this is the efficiency at the engine-room switchboard.

The percentage of loss to be allowed for the distribution by cables to the various motors is taken as 3½ per cent. at full-load, or 2 per cent. at ¾-load, as the losses vary as the square of the current; this is ample in a well-proportioned scheme. This brings the total efficiency down to, say, 80 per cent.

Table III. gives the efficiencies at full, ¾, and ½-load of a complete range of motors, and the figures are such that any first-class manufacturer will guarantee. Here again, all figures are taken from the middle column, assuming the motors to be working at ¾-load.

We can reasonably assume the motor units in our example to be 5 and 10 B.H.P., and taking 83 per cent. at ¾-load as being the mean

efficiency of the motors, we have a total efficiency at the motor-pulleys of 66⅔ per cent. In the case of the individual machine driven direct, it is obvious that no further loss takes place, but when the machine is driven by gearing, chain, or belt, there is a loss of 2½ to 5 per cent., and this must be deducted from the efficiency at the motor-shaft. Evidently then, where it is possible to drive the whole of the machinery by the above-mentioned methods, the balance is distinctly in favour of electrical driving.

Table III.—Efficiencies of Motors.

B.H.P.	Full load.	¾-load.	½-load.
1	76	75	71
2	80	79	76
3	82	81	77
5	83	82	78
7½	84	83	79
10	86	85	81
15	87	86	82
20	88	87	83
25	89	88	85
35	90	89	85
50	91	90	86
75	92	91	87
100	93	92	88

As far as engineering works are concerned, latter-day practice shows a decided tendency towards this method of driving, as the power required to drive small machine tools has been greatly increased by the advent of high-speed tool steels, and increased cutting speeds. However, in the majority of electrically-driven works, it can reasonably be assumed that from one-quarter to one-third of the power is taken up by group-driving. We will take the latter to be the case, so continuing with our example, we have two-thirds of the available power reduced a further 3½ per cent.

The following table, which has been compiled from tests I have had taken at hazard, shows that the frictional losses in well-arranged group-driving should vary from 10 per cent. to 25 per cent.:—

Turning again to the electrical side, when running the engine at full-load, we shall have a slightly higher efficiency. The combined efficiencies of the engine and generator, together with the cables, will be:—

	Full-load.	¾-load.	½-load.
Engine generator ...	85	82	76
Cables	96½	98	99
Resulting in	82	80	75

From this we get the electrical power available at the motor terminals, namely:—

Full-load.	¾-load.	½-load.
109	80	50 E.H.P.

The motors are assumed to be working at ¾-load (it must be remembered that the engine is at full load, because of extended plant, and not because the load on the motors has been increased), or 7½ H.P. We must deduct the friction on the working side of the motor, which will be constant at all loads, but this time proportionate to the greater output at full load.

Tabulating the results, we thus have:—

	Full load.	¾-load.	½-load.
Indicated horse-power of engine ...	133	100	67
Electrical horse-power at motor terminals	109	80	50
Brake horse-power at motor shaft ...	90	62	36
*Effective horse-power applied to machines	82	54	28
As compared with the result of mechanical transmission	76	43	10

* Arrived at by deducting the frictional losses of 8·1 B.H.P. from the B.H.P. at motor shaft.

This leaves us a margin in favour of electricity of 6 H.P. at full load, 11 H.P. at ¾-load, and 18 H.P. at ½-load.

There is yet another feature to be considered, and that is—whereas the frictional losses are usually constant in mechanical cases down to the lowest loads, through the inconvenience of throwing out sections of shafting, in electrical driving the idle section is at rest as the motor is stopped. This removes the motor and frictional losses in that section, but in our example we have taken it as though all the motors were running on the lower loads at a necessary lower efficiency.

(To be concluded.)

Table IV.—Efficiency Tests of Group Driving.

Test No.	B.H.P. of motor.	Nature of work driven.	No. of machine tools.	Total length of line shafts. Feet.	Diameter of line shafts, inches.	Average r.p.m. of line shafts.	No. of line shaft bearings.	No. of belts.	Output in B.H.P. at motor shaft.	B.H.P. absorbed by shafting, belts, &c.	% to drive shafting, belts, &c.
1	3	Two 30-in. Bullard boring mills, one No. 5 Herbert capstan lathe	3	16	2	230	3	7	2·3	·46	20
2	4½	Two horizontal boring machines, one radial drill	3	20	2	180	5	7	3·1	·4	13
3	4½	*Tool Room.—Small lathe, shaping, slotting, milling, and drilling machines. Three tool grinding machines, metal saw and fan*	11	36	2 (Two)	230	7	15	3·4	1·7	50
4	5	Four fine wire drawing machines, a washing and mangling machine and pump	6	86	1½ (Two)	210	17*	8	4·75	1·06	22·5
5	7½	Wire netting weaving frames	3	42	1½	180	7*	5	6·3	·67	10·5
6	7½	*Two large lathes, planer, slotting machine, and cylinder boring machine*	5	150	2½ (Two)	95	15	11	3·85	2·3	60
7	10	Five wire gauze weaving machines	5	70	1½	360	12*	6	5·16	1·31	25
8	15	*Lathes, shaping, planing, milling, and grinding machines*	18	128	2¼ *in. to* 3 *in* (Three)	106	22	27	7·2	4·7	65
9	25	*Vertical and horizontal milling machines* ...	71	315	2½ *in. &* 1½ *in* (Nine)	169	42	95	25·25	11·35	45
10	30	*Boring and turning machines, lathes, drills, &c.*	102	673	2¾ *in. &* 2 *in.* (Ten)	138	91	181	28·2	10·5	37·2

* Roller bearings.

For the remaining plant, we will then assume a liberal frictional loss of 20 per cent., which gives a total efficiency of 60 per cent. for electrical distribution, as against 55 per cent., which was taken as the fair average for mechanical distribution.

Up to the present we have assumed the engine indicating ¾-load, but to render our comparison more complete, we will assume that the plant is extended until the engine is brought up to full-load. Then, taking the mechanical case, the losses will increase in proportion, excepting that, roughly, 10 per cent. being the engine friction, remains constant. This means that the efficiency on full-load will be about 57 per cent, instead of 55 per cent. But now we shall have greater proportionate losses on the lower loads, due to added shafting, &c.

To return to our case of 100 H.P. at ¾-load—

	Full-load. 133	¾-load. 100	½-load. 67 I.H.P.
The losses are now 43 per cent. at full-load ...	57	57	57 I.H.P.
Leaving	76	43	10 effective B.H.P.

We now have an effective power of 43 B.H.P. at ¾-load, as against 55 B.H.P. when the plant was only taking three-quarters of the load of the engine.

HIGH PRESSURE INSULATORS.

[COMMUNICATED.]

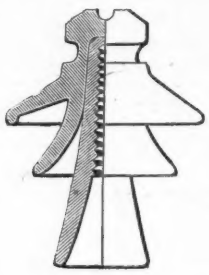
The following remarks about high pressure insulators may prove interesting to many readers of the Electrical Review. The subject is an all-important one in these days of overhead transmission lines. There appears to be a considerable difficulty in making large insulators to withstand a testing pressure of from 50,000 to 70,000 volts, and makers are now taxing their powers of ingenuity to find the most efficacious and lasting form.

It is evident that there is much to be desired in the present form, as it is made in England. Practical experience has proved to English makers, as well as Continental, the advantage of making large insulators in two pieces as shown below, as they find it is impossible to make large masses of vitreous ware in one piece.

E

It has been found that small insulators made of good porcelain can easily stand pressures at, and above, 60,000 volts.

Foreign manufacturers have experienced breakages owing to screwing the spindle direct into the porcelain, and have found the necessity of wrapping the screwed ends with hemp or some other suitable material to allow for the unequal expansion of the iron stalk and the porcelain. The resistance of highly vitreous porcelain itself is practically unlimited, and the only leakage which can take place is caused by the



High Pressure Insulator.

moisture and dirt which collect on the surface; therefore, to be thoroughly good and efficient, an insulator should have as large a surface as possible, of which the greater part should be unexposed.

The following are the particulars of some tests of insulators made by an English firm. In the majority of cases the insulators have failed on account of some mechanical flaw. In a good many instances the weak point appeared to be the neck, although the thickness of porcelain at this point was much greater than that between the slot for the wire and the top of the stalk. This, no doubt, was due to the larger mass of porcelain at the neck not being properly vitrified. These tests are all at 60,000 volts for one hour's duration.

Test.	Percentage of breakdown at the end of 1 hour.
1	48 per cent.
2	44 „
3	25 „
4	29 „
5	41 „

It is noteworthy that all these insulators were of one piece, whereas with the insulators made in two pieces, which were tested at the same time, no breakdown occurred.

A NOVEL TELEPHONE JOURNAL.

We have lately received the first issue of a monthly journal published by the newly-founded Association of Telephone Subscribers in Paris. This Association was founded in May last for the purpose of conducting an organised agitation against the defective telephone service in Paris furnished by the French Telegraph Administration. The Association has as president the Marquis M. de Montebello, who is assisted by a council numbering among its members well-known business men in Paris. The objects of the Association are to effect an improvement in the Paris telephone service, which has long given cause for much complaint, to modify the drastic rules and regulations by which the Paris telephone subscriber is governed, to increase the development of the service and to reduce the rates. With the object of obtaining the maximum amount of publicity for the grievances of the Paris telephone subscriber, and for the opinions and investigations of the Association, an official monthly journal has been started, the first number of which shows that it promises to be a highly interesting contribution to the periodical literature of the telephone.

The paper begins with an editorial by the president of the Association which sketches in broad lines the objects aimed at, and the programme which the Association has laid down for itself. This is followed by various notes showing the interest aroused by the formation of the Association of Telephone Subscribers, both among other official bodies and in the Press. A description is given of the recent legal actions brought by the French Telegraph Administration against subscribers for the use of violent language to the operators. The most famous of these trials was that of Mlle. Sylviac, who, it will be remembered, was acquitted of having committed an offence against that august functionary, the Paris telephone operator. The two most interesting articles are a description of a visit made by the Council of the Association to the principal telephone exchange in Paris, and a statement of the grievances of the telephone operator, which is signed by a "group of operators."

In his editorial article, M. de Montebello points out that the Association cannot be suspected of being the advance guard of any financial combination, of being moved by political ambitions or of being irresponsible agitators anxious for notoriety. The simple object of the Association is to give organised effect to the demand of all telephone subscribers who wish a better and cheaper service. The telephone question, he says, meaning the question of the telephone service of Paris, is more complicated than it seems at first glance, and to understand it thoroughly it must be regarded under three main aspects: regulations, organisation, and financial management. The regulations, he says, are arbitrary and vexatious, and have hitherto been borne by the subscribers with sheep-like docility. It is insufferable, for example, that the Administration should have the power, while charging the full subscription, arbitrarily to cut off a subscriber's service or to bring the subscriber into Court on account of a few lively remarks to a telephone operator, as if an outrage had been offered to a high dignitary of the State. As to the organisation of the telephone department, M. de Montebello says that departmental methods reign to such an extent that it is not astonishing that there should exist the inefficiency which generally results from bureaucratic management. Not much, he says, can be done here, but nevertheless, he promises that the Association will do its best to disturb the inertia of the department and to turn the search-light of publicity on routine methods, in the hope of obtaining much-needed reform and progress. As to financial management, the main trouble is that all the revenue from the telephone department is promptly absorbed by the Treasury, and that all credits for the improvement of the system and of the staff are pitilessly refused. This, at any rate, is said to be the explanation of the Under-Secretary of State in charge of the telephone service, but it appears that, in future, if the Under-Secretary is insistent in his demand for money for the amelioration of the telephone service, he will have the active support of the Association of Telephone Subscribers. As to the line of action which the Association should pursue, various courses have been suggested, ranging from an alliance with the Administration to a declaration of open war against the Administration. M. de Montebello's opinion is, that the Association should remain independent, giving the fullest publicity to the difficulties and abuses connected with the telephone service, and demanding the necessary reforms without prejudice, but with vigour, not employing extreme measures until more temperate methods fail—in short, a sort of guerrilla warfare, conducted on lines which have been known to produce results in the past. A legal advisory board has been established, which will thoroughly investigate the legal aspect of the regulations affecting telephone subscribers and their relations with the telephone employés, and technical committees are to be appointed to study the working and development of the telephone in France and in other countries. Local committees will be established among the subscribers to bind them into a powerful organisation. M. de Montebello concludes with an eloquent appeal to French telephone subscribers in general to support the Association and give it the strength which numbers lend.

A short note registers the successes which have already been achieved by the Association in its campaign against the Telegraph Administration. The first of these is the acquittal of Mlle. Sylviac, which was largely due to the movement of public opinion aroused by the Association. The second is the abrogation by the Administration of the clause in the Telephone Regulations under which the

Administration formerly exercised the right to cut off telephone subscribers who offended the telephone employés. It seems that about 200 subscribers each year had their services arbitrarily discontinued by the Administration under this rule. The third important result of the agitation has been a demand made in Parliament by the Under-Secretary for the necessary credits to add 237 operators to the Paris telephone staff. This request for additional operators is claimed to be solely due to the intervention of the Association of Telephone Subscribers.

A most interesting account is given of the official visit of a number of members of the Council of the Association to the main telephone exchange in Paris. The visitors were received by the chief engineer of the Paris division of the Telegraph Administration and by the manager of the exchange. Asked what were the principal causes of the slow and defective service of which Paris telephone subscribers complain, the officials gave the following reasons :—

1. The insufficient number of lines (presumably junction lines).
2. The insufficiency of staff.
3. The impatience of the subscribers.
4. The nervousness of the operators.

Asked whether the number of subscribers served by each operator was not excessive, the official reply was that the number of subscribers had no bearing, the number of calls was the point to be considered. According to the official statistics the number of calls per operator's position in 14 hours was 1,000, or an average of 70 per hour. During the busy times of day, however, the rate of calling is twice this figure, and operators frequently have to deal with calls at the rate of 150 an hour.

These figures seemed to astonish the visitors, and they immediately asked for the explanation of the interminable waits of which they all had frequent experience.

The answer to this was simple and truly official. "*The subscribers do not know how to use the telephone.*"

The explanation of this retort on the visitors was that a subscriber, once having called by pressing his button, must wait until the operator answers. If he presses the button again, or hangs up the receivers, he runs the risk of not being answered at all. The officials also alleged that besides making mistakes in calling, 60 per cent. of the subscribers neglected to give the disconnection signal, which prevented the operators from giving new connections with rapidity.

The comment of the visitors on this explanation of the subscribers' defects showed that the official view was hardly convincing. It is worth quoting textually :—

"To sum up, then, and this is quite in accord with all the principles of the Administration, if we do not get a good service, if we often have to wait twenty long minutes for an answer from the exchange, it is all our fault."

The officials were not quite willing to go as far as that, but they certainly were of opinion that the responsibility for the bad service was largely shared by the subscribers. The real cure for the trouble, said the officials, rather inconsequently it may appear, was more money—more money for lines, for stations, for switchboards, and for increase of staff. The visitors pointed out that the staff seemed already sufficiently numerous. The official reply was that there were 1,800 operators on the Paris staff. Of these about 325 are always on sick leave, and about 70 are engaged in other than telephone work, leaving an active staff of 1,400, which is considered insufficient. The exact number of subscribers in the Paris system is not stated, but it appears to be in the neighbourhood of 35,000.

A discussion on the financial aspect of the telephone service followed, but on these questions the officials guardedly refrained from giving any opinions. The chief engineer, however, threw a side-light on the difficulties under which the Paris telephone system labours, by pointing out that it was only in December, 1903, that a credit of 3,000,000 fr. was voted for new telephone exchange apparatus which had been demanded three years previously. As the manufacture and installation of a large multiple switchboard requires about 15 months, it seems that something like five years must be allowed for urgent work in the French Telegraph Administration.

The visitors were shown over the exchange, and the method of working was explained in detail by the officials. The impressions which the visitors note as a result of their inspection, are as follows :—

The work of the operators they considered trying and fatiguing, principally because the exchange is very badly equipped. With more modern and better-designed apparatus, the operators would give a better service with less effort. In any case, an increase of staff seemed absolutely necessary ; at least 120 operators should be added to the staff of the main exchange. The visitors consider increase of staff necessary in order to provide substitutes for absent operators, and in order to lighten the work of the operators in charge of the inter-urban lines ; these have to keep records in addition to the regular work of operating, which complicates the work and slows down the service.

The other side of the story, or, rather, a contribution to the same side from a more intimate point of view, is contained in a letter to the president of the Association from a group of telephone operators. This communication is couched, as might be expected, in somewhat hysterical terms. The operators complain that they have too many subscribers to serve, and that the subscribers are not as polite as they might be. The volume of work increases steadily, and, at the same time, the work becomes more difficult to do, on account of defective apparatus. The complaining operators, however, have the sense to see that definite figures are more convincing than general complaints, and they give figures of some interest. Each operator, they say, serves at present from 100 to 120 subscribers, whereas it is materially impossible to serve effectively more than 75. Incoming junction operators each serve 15 lines, whereas the maximum that she can handle satisfactorily is 10. Exact statistics, say the operator, show that an answering operator has been known to deal with 252 calls in two morning hours—104 calls from nine to ten, and 148 from ten to eleven. An incoming junction operator has been known to handle 326 calls in two hours—147 from nine to ten, and 179 from ten to eleven. These figures show, according to the opinion of the operators, that the employés are greatly over-worked, and under such conditions they cannot be expected to give good service.

The operators also claim that there is great necessity for an increase of the number of junction lines between the various exchanges. All subscribers, they say, are familiar with the fact that there is an insufficient number of these lines, as their calls are frequently met with the reply—"all lines occupied."

A further improvement imperatively demanded, say the operators, is the installation of new switchboards. The majority of those now in use are worn and defective, with plugs out of order, annunciators out of order, and jacks and cables out of order, giving rise to false tests, contacts between neighbouring lines, noisy lines and bad transmission.

We fancy that the complaint of the operators against the defective apparatus is better founded than that of the excess of work. With modern apparatus, the figures given above for the number of calls dealt with in the busy hours would not be at all excessive. We believe that there are many exchanges in this country where the number of calls per hour which the Paris operators deem an overload, is far exceeded. From a reading of the *Journal* of the Paris Association of Telephone Subscribers, it seems to us as if the reforms which the Association should most urgently demand of the authorities are a radical improvement in the technical equipment of the system, and better training and organisation of the operating staff.

CLOSING PIECES.

THE last piece of pipe which is put into position in a range of pipework is usually called a closing-piece. For want of a distinctive name to denote the type of problem presented by the junction of one piece of work with another, the above title has here been chosen to represent the last piece of work which must be performed to join any two separately-undertaken manufactures. The absence of exact definition of such "closing pieces" of work in a specification is the cause of

many of the muddles which occur in contracts carried out jointly by two or more firms.

A flagrant case in point came under our notice recently. A large three-throw pump was to be electrically driven, spur-gearing being introduced to give the necessary speed reduction. The motor specification provided that the motor spindle should be extended beyond the bearing, and be provided with a keyway for a raw-hide pinion, while the pump specification asked for an exactly similar provision for the gear-wheel. The necessity for providing the reducing gear had not obtruded itself on the notice of the writer of the specification. The mistake was only discovered on receipt of an inquiry by the electrical firm as to which end of the motor shaft was to be extended; a considerable amount of internal friction in the buying firm was the consequence.

Although it is to be trusted that such awful examples are rare, the delimitation of contracts presents many pitfalls to ensnare the unwary. For example, an engine and dynamo, erected by separate firms, are to be painted. Who is to do it—the engine builder, the dynamo maker, or the buyer? Who is to choose the colour, and who is to settle the amount of finish necessary? Unless the specification lays down the law, irritation may arise over points not essential to the good working of the plant.

An electrical contractor is fortunate enough to secure the order for generators and switchboard for a power station. Does he, or the buyer, provide the connections between the machines and the board? And—a point more likely to be overlooked—who is to connect the outdoor cables to the board?

In the actual carrying out of junction work, some judgement must often be exercised. It is too often the case that studs fitted "to drawing" by one contractor do not entirely coincide with the position of the stud-holes, also drilled "to drawing" by another firm, when the two pieces of work are brought together. Difficulties of this sort are usually overcome by means of a template sent by one contracting firm to the other by mutual arrangement. In some cases, however, it is found better to send one part fitted, the other with its flanges undrilled, the necessary junction work being done *in situ*.

The aim of the buying firm should be, of course, to throw the onus of possible mistake on the contractors. For this reason it is often advisable to give the whole of a contract to one firm, even at a slightly increased figure to cover middleman's profit, allowing that firm to give sub-contracts, doing all possible fitting before coming on site. The absence of confusion, and the freedom from encumbered ground space and superfluity of workmen during erection, will in many cases compensate the buyer for the extra money spent.

In cases where slight dimensional inaccuracies are shown by experience to arise almost inevitably, except at the cost of precaution so excessive as to be too costly, "give-and-take" provisions should be made. For example, when ordering pipework to connect separate pieces of plant such as engine and boiler, while the drawing should show such dimensioned lengths of pipe-section as to ensure easy handling on delivery, the draughtsman should omit length-dimensions from the closing-pieces, marking them "to template." If this is done, the pipework is erected as far as the closing-piece, and a wood template is made showing the relation of flanges and position of bolt-holes. This, on being sent to the pipe-founders, enables them to supply a template-piece which goes into place without the chipping of flanges and filing of bolt-holes that is sometimes resorted to.

A very interesting example showing the variety of considerations necessary in defining the limits of a contract is that of a large steam-driven alternator. Usually one or more of the engine bearings also carries the alternator shaft, and the engine fly-wheel is utilised to support the field-poles of the alternator. The points to be arranged between the two firms are, who is to provide the shaft, coupling, rotor fly-wheel and outer bearing (if any) for the alternator, and what dimensions of the fly-wheel are necessary to provide the correct peripheral speed for the field-poles, and to reduce the angular variation of phase of the alternator (due to variation of turning moment of the engine) to reasonable limits? The last point must be fixed by the alternator builders from a knowledge of the impedance of their alternator windings, and the amount of cross-surge permissible. The other points are matters of arrangement. In one such case, the engine builders designed one end bearing to take its proportion of the alternator weight, and provided a half-coupling on their shaft and a separate outer bearing for the alternator. A firm of Bessemer steel makers delivered the alternator shaft on site, turned and fitted, the engine builders afterwards scraping their bearings to make a final adjustment on this shaft, and the dynamo builders provided the fly-wheel, fixing it on the shaft. Without absolute accuracy on the part of three firms, this course would have been impossible.

Other instances could be enumerated of the way in which contracts must be carefully defined to avoid either a gap or an overlap of work at the junction points of engineering undertakings, but sufficient attention has now been drawn to an important class of problems—the best method of combining the work of separate contractors.

BUSINESS NOTES.

Stealing Electricity.—At Maidstone on Saturday, Mary Sims, of 82, Boxley Road, was charged with stealing electricity, the property of the Corporation. It appeared that the house in which the accused resided had been wired for the electric light, but had never been connected, and no meter had been put in. It was found that the seal attached to the wiring had been broken, showing that current had been used. For the defence, prisoner said she thought she was doing no harm in using the light, as she meant to pay for it. She did not know that it was necessary for her to give notice to the electrical engineer before turning on the light. She was fined 40s, or one month's imprisonment.

U.S. Electrical Exports.—The value of the electrical appliances, including telegraph and telephone instruments exported from the United States during May last, amounted to only £58,599, as compared with £62,290 in the corresponding month of last year. On the other hand, the exports of electrical machinery during the same periods increased from £99,720 to £103,592.

Engine Contracts.—Messrs. Browett, Lindley & Co., Ltd., have recently booked the following orders:—

From Messrs. James Wrigley & Sons, paper manufacturers, Bury, a 430-B.H.P. two-crank compound engine.

From Messrs. Mather & Platt, Ltd., for the Prestwich Asylum, a 270-KW. engine.

From the General Electric Co., Ltd., a 33-KW. engine for Cairo Mill, also a 33-KW. engine for Cromer Mill, Middleton.

From Messrs. Johnson & Phillips, a 25-KW. engine.

From Messrs. Mather & Platt, Ltd., for the Admiralty Dockyard, Simons Bay, two 250-KW. engines.

From the Industrial Engineering Co., Ltd., Hyde, one 25-B.H.P. engine for the Magnesium Metal Co., Patricroft.

From Messrs. Dick, Kerr & Co., Ltd., for the Gosport and Fareham trams, three 500-B.H.P. engines, each complete with surface condenser.

From Messrs. Johnson & Phillips, Ltd., for the Abosso Gold Mining Co., one 31-KW. engine.

From the Trafford Power & Light Supply Co., Ltd., one 15-B.H.P. engine.

From Messrs. Dick, Kerr & Co., Ltd., for Bangkok, three 200-KW. engines.

From the War Office, for the Royal Arsenal, Woolwich, a 500-KW. triple-expansion engine, coupled to a generator by the British Westinghouse Co., Ltd., complete with surface condensing plant.

Japan.—The Japanese Customs authorities have lately given a decision to the effect that "underground telegraph cable" is dutiable under No. 483 of the Tariff at the rate of 10 per cent. *ad valorem*, and not the 5 per cent. provided for telegraph wire in the commercial treaty between Japan and Germany.

Germany.—The quantity of foreign electrical machinery imported into Germany during the four months ending with May last is returned at 379 tons, as compared with only 213 tons in the corresponding four months of 1903.

Imports of Foreign Electrical Fittings. — The imports of foreign electrical goods and apparatus into this country during last month amounted to £56,170, bringing up the total for the first six months of the year to £384,098, which compares with £360,914 in the corresponding half of 1903.

Bitumen Contracts. — Messrs. Rowland Carr & Co. have secured the order for the bitumen required for the Government dockyards at Portsmouth and Pembroke. They have also received, through Messrs. Johnson & Phillips, the order for the 286 tons of bitumen required for Handsworth.

"S.S." Telephones.—A new inter-communication telephone system which is claimed to ensure an absolutely secret service is being introduced by the General Electric Co., Ltd. The chances of tapping the line and the possibilities of leakage are stated to have been entirely disposed of, and it takes its name, the "S.S.," from the secrecy of the service which it affords. In construction it is somewhat of a departure from the usual form of instrument, and it embodies the latest developments in telephony. Each pair of instruments has a complete metallic circuit, the instru-

ment cannot be left out of call, two stations cannot be accidentally rung up at one time by careless placing of the switch, and there is no chance of cross-talk; inductive effects are entirely eliminated. The method of operation is simple, an operator being able to put himself into direct communication with any other station on the system, simply by inserting a plug and pressing a ringing key. From the illustration of the wall pattern it will be seen that there

Fig. 1.

are a number of drop indicators corresponding with the number of lines, and immediately below these are the "jacks" or plug sockets. A connecting plug with a length of flexible cord is also provided which is inserted into any "jack" according to the number of the line it is desired to communicate with. When a call is made the indicator corresponding with that particular line falls, denoting at once who is calling. Should the office be vacant when the call is made, this indicator clearly shows a person on returning that a call has been made and who it was that "rung up." The "S.S." can also be used as a central station instrument for intercommunication between outlying stations. These stations may be

Fig. 2.

a considerable distance away, and it would perhaps incur too great an expense to run a cable of the necessary size to each. With the "S.S." instrument it is possible to use a single pair of lines between the instruments at the outlying station and the central station, thus minimising the cost of wiring. The "S.S." telephone can be provided with a pair of plugs which enables the calling station to be connected through to any other station on the system.

The wall pattern set consists of a "Hunningscone-Deckert" hand combination, with the switch in the handle, but the table pattern, while consisting of similar parts, has the bell mounted at the back and the cradle rest on top.

Bankruptcy Proceedings.—The adjourned meeting of the creditors of Henry Binko, electrical engineer, 34, Leadenhall Street, E.C., and 4, Highbury Crescent, N., was held on July 29th, at the London Bankruptcy Court, before Mr. E. Leadam Hough, Senior Official Receiver. The debtor had been a director of the Patent Speaking Tube Co., which he has financed, and to his connection with which he partly attributes his appearance at the Court. The company has instituted proceedings against the Commercial Union Assurance Office for breach of contract in failing to guarantee £35,000 of its debentures, and the debtor looks to the result of the trial to enable him to pay all his debts in full, his accounts showing liabilities £4,914, and assets of much larger amount, chiefly represented by his interest in the Patent Speaking Tube Co. The former meeting was adjourned to await the result of the litigation before appointing a trustee, but resolutions were now passed for the case to remain in the hands of the Official Receiver, and for that official to apply to the Court for an order of adjudication; but that no application to that end be made for 14 days from that date, and that in the event of a decision in favour of the plaintiffs in the action brought by the Patent Speaking Tube Co. against the Commercial Union Assurance Office being obtained within the said 14 days, no application for an order of adjudication to be made for a further 14 days in order to give the debtor an opportunity to pay his creditors in full within the said extended period of 14 days.

The debtor attended on Monday before Mr. Registrar Giffard in relation to his public examination. Mr. C. A. Pope, Senior Official Receiver, reported that he was not prepared to proceed until the litigation in the High Courts had been decided. The hearing was adjourned until October 26th.

Dissolutions and Liquidations.—A meeting of the Ljungstrom Engine Syndicate is to be held at 5, Collingwood Street, Newcastle-on-Tyne, on September 2nd, to hear an account of the winding up from the liquidator, Mr. A. W. Brewtnall.

Messrs. L. P. and A. B. Brenchley and H. F. Holman (Brenchley Bros. & Holman, general electrical and mechanical power engineers, of New Street, Ashford) have dissolved partnership. Mr. Holman will attend to debts, and will continue the business under the old style.

A meeting of the Electric Construction Corporation is to be held at Dashwood House, on September 29th, to hear an account of the winding-up from the liquidators (P. E. Beachcroft and E. Garcke). It will be remembered that the company went into liquidation in 1893 to transfer its undertaking to the Electric Construction Co., Ltd., which is still carrying on a progressive business at Wolverhampton.

Book Notices.—*Ready Reference Tables.* By Carl Hering. Vol. I.—Conversion Factors. New York: John Wiley and Sons. London: Chapman & Hall. 1904. Price 10s. 6d. net.—This is the first of a series of volumes destined by the author to form a comprehensive collection of data, based upon the most authoritative available values of the various values concerned, and including all ordinary as well as many obsolete units. "Conversion factors" for converting from one system of units to another are given, in both directions, with their 7-figure logarithms and approximate values, and all such factors have been recalculated and checked with the utmost care. The equivalents of compound units in various systems are also given. A complete index is provided, and a condensed list of handy approximations and equivalents is given inside the front cover. Altogether the author has set about his herculean task in a most workmanlike manner, and with a courage which commands our admiration. Praise must be awarded also to the manner in which the work has been produced, in clear type, on excellent thin paper, of convenient shape, and well bound in leather. To discuss the detailed tables were a task too arduous to contemplate; but we may mention that a uniform system of symbols and abbreviations has been adopted, and a complete list of them is given at the beginning of the book. The author carefully and accurately defines the meaning of the units, pointing out the errors so commonly met with through looseness of wording, such as "horse-power per hour" instead of "horse-power-hour," and explaining the method of reducing from one system to another. In fact, the author's introductory remarks on these and kindred matters are most clearly worded, and deserve close attention. Needless to say, the distinctions between power and energy, electromotive force and potential, &c., are explained, and we are glad to see that the author ignores the word "tension." With thermometric equivalent scales from absolute zero to 6,000° C. is given a "concrete scale" showing an enormous number of temperature "landmarks," so to speak. American spelling is adopted, but is comparatively unobtrusive, and we are grateful to the author for treating *data* as a plural noun. We shall look forward with pleasurable anticipation to further volumes of this admirable and useful work.

Loci in Mechanical Drawing.—Part III., Piston Acceleration. By Alex. MacLay, B.Sc., &c. Manchester: Technical Publishing Co., 1904. Price 2s. 6d. net.—This is a continuation of the work of which the first part was issued some years ago, and apparently the former volume is to be re-issued in two parts, dealing separately with Geometrical and Mechanical Loci. In the present section, curves of velocity and acceleration are dealt with in connection with the motion of the pistons of steam engines, a subject which affords an almost infinite variety of problems. The subject is treated both graphically and analytically, and is one whose interest is confined mainly to specialists. The thoroughness of the treatment, and the clearness of the text, leave nothing to be desired.

Steam and the Steam Engine. By Andrew Jamieson, M.Inst.C.E. London: Charles Griffin & Co., 1904. Price 3s. 6d.—The tenth edition of this well-known elementary manual has again been revised and enlarged, and an appendix has been added dealing with thermo-electric pyrometers, the McInnes-Dobbie indicator, steam turbines and other modern steam plant. A handsome new coloured frontispiece showing an up-to-date Lancashire boiler has been added. As in the case of Prof. Jamieson's other text-books, the work is very fully illustrated with clear drawings of engine and boiler details, and we can vouch for its excellence as an educational hand-book for students.

Corso di Elettrotecnica.—Vol. I. By Guido Grassi. Torino-Roma: Casa Editrice Nazionale. 1904.—This volume treats of alternators, dynamos and transformers in the order named, the greater space being allotted to the first-named. The author plunges almost at once into the theory of alternators, both single and polyphase, without wasting space on historical digressions and generalisations, as is too often thought the correct proceeding by the writers of text-books. The treatment of the direct-current generator follows

naturally on that of alternators, and is followed by typical examples of both classes; we note amongst the latter details of machines for direct coupling to turbines. The theory and design of transformers are also fully treated. The whole book is well illustrated with beautifully clear drawings, and is otherwise well produced, save the binding. Italian students are to be congratulated upon the possession of so lucid and comprehensive a treatise.

The "F. E. Coe Red Book on Advertising." London, 19-21, High Holborn: F. E. Coe. 2s. 6d. net.

Mr. C. Rockley, who has been for some years official canvasser and outdoor representative for the West Ham Corporation electricity department, has written a pamphlet setting out in an attractive manner a number of "Specific Reasons why every Tradesman should use the Electric Light." When gas companies are so active in trying to persuade the general public that it has nothing to gain by adopting such a luxury as electric lighting in place of gas, it is desirable that electricity supply departments should see to it that they leave nothing reasonable undone which is likely to help to convince the public that the advantages of electric lighting are very great indeed. In this little pamphlet Mr. Rockley discusses these special advantages from the stock-keeper's standpoint, a course which is more likely to appeal to the tradesman than any amount of argument controverting the exaggerated circulars of the gas companies. There is a page devoted to the benefits accruing to the boot and shoe dealer, one meeting the case of the butcher, others being concerned respectively with the draper, the florist, the greengrocer, the hosier, the jeweller, the publican, the printer, and so on. There are two issues of the pamphlet, 44 and 32 pages respectively, and they can be obtained from Messrs. Jacomb Bros., publishers, Wingfield Road, Stratford. Managers of electricity supply departments, who are anxious to see specimens, should place themselves in communication with that firm.

"The Indicator Handbook." By C. N. Pickworth. Part II.—The Indicator Diagram: Its Analysis and Calculation. London and Manchester: Emmott & Co., Ltd. 3s. net.

"Etude Economique sur la Transmission Electrique de la Force dans les Usines et les Ateliers." By R. Swyngedauw. "La Transmission Electrique de l'Energie dans les Pays Industriels de Houille Noire." By R. Swyngedauw. Paris: Vve. Ch. Dunod. Fr. 2 and Fr. 5 respectively.

Annual Outings.—On Saturday, July 23rd, the employés of T. Clarke & Co., electrical engineers, Sloane Street, W., held their annual outing at Bognor. Dinner was served at the Waterloo Hotel. The toast of "The Firm," proposed by Mr. Wiggins, was, in the absence of Mr. T. Clarke, replied to by Mr. E. Clarke.

The third annual outing of the Ilford Electricity Department was held on Saturday, 23rd ult., at Clacton-on-Sea. In the absence of Mr. A. H. Shaw, the chief engineer, Mr. Bond presided at the dinner, which was held at Day's Restaurant.

The employés of the Windsor and Eton and Slough and Datchet Electrical Supply Cos. had their annual outing on Friday, July 22nd, when they went up the river as far as Marlow by steam launch. The party numbered altogether 85. Mr. A. E. Farrow, chief engineer of both companies, presided, supported by Mr. R. Rawkins, auditor, and the chief officials of the staff. A cricket match was played—"Electrical *v.* Visitors"—the former being a team of the home staff. The visitors were easily disposed of for 27 all out, and the homesters made 62 for two wickets.

On July 30th the Ealing Electricity Works staff and employés (33 in number) went for their first annual outing, taking train to Windsor and steam launch on to Marlow. A cricket match, "Inside Staff" *v.* "Outside Staff" resulted in a victory for the latter, but in a subsequent Tug-of-War the Insiders were twice victorious. Dinner and tea were served at the Crown Hotel. Mr. Douglas Knight, the borough electrical engineer, presided, being supported by his chief assistant, Mr. A. E. Pullen.

Fire Prevention.—The British Fire Prevention Committee's Publication No. 82 gives the standards of fire resistance adopted by the International Fire Prevention Congress in London last year. Special attention is directed to the common misuse of the word "fire-proof," which, it is suggested, should be replaced by "fire-resisting" when used to describe the qualities of materials and structures intended to resist the action of fire for shorter or longer periods. (Price 2s. 6d.)

For Sale.—On August 9th, at Coventry, Messrs. P. Huddleston & Co. will offer for sale by auction the plant of a motor manufacturing company, and the stock of an electrical engineer. See our advertisements.

Trade Announcements.—Messrs. A. Vandam & Co., have opened a warehouse and offices at Johannesburg. At their show rooms in Government Square, they keep a selection of samples of all classes of electrical supplies. Their postal address is P.O. Box 4,941, Johannesburg. Mr. Vandam was formerly trading with Vandam, Marsh & Co., Ltd., in London.

Messrs. Felten & Guilleaume and Messrs. W. F. Dennis & Co., both write to say that their deliveries will not be affected in any way by the St. Petersburg fire, which was recorded in our last issue, as the factory was established exclusively for supplying Russian demands. The Mülheim-am-Rheim works are in full operation. The St. Petersburg works were fully insured.

The A.E.G. English Manufacturing Co., Ltd., is now starting business at 4, New Compton Street, Charing Cross Road, where a large stock will be kept. The company has acquired the English Nernst lamp patents from the A.E.G., of Berlin, and will look after the Nernst lamp business in England. All lamps and burners will in future be marked "Aegma." We are informed that owing to the rapidly increasing demand for Nernst lamps it is intended to build a factory in this country. A price list of novelties will shortly be issued.

Mr. A. H. Hunt, of 115-117, Cannon Street, E.C., announces that the agency which he has held during the last three years, for the Walsall Electrical Co., has been determined by mutual consent. He will continue to supply electrical appliances and machinery for high-tension and power work. He is still representing several firms, and will continue to carry large stocks. The Walsall Co. ask that for the present all communications for them should be sent to 57, Bridge Street, Walsall.

The British Uralite Co.—In the Chancery Division on Tuesday Mr. Justice Buckley sanctioned the reduction of the capital of the British Uralite Co., Ltd., from £300,000 to £200,000 on the petition of the company. Counsel said the company had paid no dividend from its beginning, and on the current trading year it had made a loss to the extent of £80,000, which had to be met out of capital.

Catalogues and Lists.—The Mirrlees, Watson Co., Ltd., of Glasgow, have sent us a copy of a new pamphlet just issued by them describing their "Yaryan" water distilling apparatus for boiler feed and other purposes. Where water cannot be satisfactorily treated by any chemical system, distillation is the only remedy. Hitherto the great objection to water distillers has been the cost of fuel, but it is claimed that with the firm's sextuple effect Yaryan distillers the amount of fuel used has been very greatly reduced. There must be many places where a decided benefit would be obtained in the installation of an economical distilling plant, as, from the sea or almost any other water, however impure, a good pure water could then be obtained by means of distillation. With the Yaryan apparatus it is said that as much as 44 lbs. of water have been evaporated and condensed per lb. of coal used. Illustrations and a specification of the apparatus appear in the pamphlet, also details of working results which have been obtained from its use.

Messrs. Lacy-Hulbert & Co., Ltd., of 25, Victoria Street, Westminster, S.W., have placed before us a number of lists of their special lines. Their "Boreas" patent air compressors of the class Y type, which are made specially suitable for electric driving, are described in one of the lists, and we understand that the firm is at present supplying these to electric lighting and tramway stations for use in blowing dust out of generators, &c. Other lists in the same series particularise their portable electric drills, and electric pulley blocks.

Mr. C Bernard, of 76, Finsbury Pavement, E.C., who is representing Messrs. Carla Porta & Co., of Milan, in this country for their electric light and gas fittings, and has some of these manufactures on show at the Italian Exhibition now running at Earl's Court, has placed before us a book of designs, showing some very attractive work in the way of electroliers, standards, brackets, and so forth.

Messrs. Ferranti, Ltd., of Hollinwood, have issued some new lists. No. 1 describes and prices their reverse current relay for continuous current circuits; No. 2 contains prices and particulars of moving coil instruments (8 in. round type); and No. 3 is a price list of shunts for moving coil ammeters.

There has been issued by the publishing department of the British Westinghouse Electric Co. a new publication entitled "One Million Horse-Power." It is got up in their usual attractive form, giving a list of the more important electrical installations carried out by the company in the United Kingdom and the Colonies. A number of half-tone illustrations reproduced from photographs of some of the work are distributed over the 80 pp. of the book.

The Brush Electrical Engineering Co., Ltd., is pushing a convenient battery fan, and also the Brush lamp-holder fan just now by means of a new circular relating to them, and while the hot weather continues such specialities are sure to be in demand.

Messrs. D. Santoni & Co., Ltd., of 28, Ely Place, W.C., have just issued a leaflet detailing their "Perfect Locking Non-Loosening 'Minne' Lock Nut."

LIGHTING AND POWER NOTES.

Barmouth.—At a special meeting of the U.D.C., it was resolved to accept the terms of the company which proposes to supply the town with electric light, subject to the ratepayers' sanction being obtained.

Birkenhead.—The result of the past year's working, as shown in the abstract of accounts just issued, is a net surplus of £1,386, as against £1,195 in the previous year.

Bo'ness.—The Town Council has signed an agreement with the National Electrical Construction Co., the contractors for the electric lighting of the burgh, which provides that the works are to be completed within the next nine months, and that the T.C. is to pay the company for the installation £24,689, subject to deductions amounting to over £1,200, including the cost of a site for the station, recently purchased by the Town Council.

Burnley.—The Electricity Committee has recommended the T.C. to reduce the charges for meter rents to 6d. per quarter up to 50 amperes, and to 1s. above, instead of 2s. 6d.

Burslem.—A L.G.B. inquiry was held on July 26th relative to the application of the T.C. for a loan of £21,000 for E.L. purposes, and £10,000 for the provision of a refuse destructor. There was no opposition.

Bury (Lancs.).—The R.D.C. has received from the Lancashire Electric Power Co. an intimation that it intends applying for powers to supply within the Council's area.

Christchurch, N.Z.—The supply of electrical power from a small plant installed in connection with a refuse destructor, which has been undertaken during the past eight months by the City Council, has proved very successful. The supply was commenced in August last, 1,333 units being sold during the month, and in March 10,737 were sold, the revenue in August being £34, and in March £259. In April the units sold had increased to 12,852, and the revenue to £285, the profit for that month (after allowing for running expenses, interest at 4½ per cent., and depreciation at 7½ per cent.) being £94. The destructor loan amounted to £13,000. —*New Zealand Herald.*

Croydon.—A loan of £8,415 for E.L. purposes has been applied for by the T.C., and additional plant, comprising a motor-alternator, complete with switchgear and cables, is to be laid down, at a cost of £1,350.

Dalkeith.—The T.C. has resolved to accept the offer of Messrs. Crompton & Co. for the supply of electrical energy for the pumping of the water at the Dalkeith bores at Bridgend, provided the company agrees to certain conditions safe-guarding the interests of the burgh, in the event of any cheaper offer being made by them to any other party in the burgh at any time within the next 10 years. The price quoted by Messrs. Crompton was 1½d. per unit, with a reduction of 8 per cent. if the consumption exceeds 10,000 units per quarter.

Dewsbury.—Much inconvenience was caused on 29th ult. by the fusing of one of the electric light mains in the centre of the town. Simultaneously, wires fused at tradesmen's premises in the vicinity, two fires resulting, which were extinguished by the fire brigade before much damage had been done. In consequence of successive faults the supply had to be suspended during the night.

Dover.—The T.C. has applied for a loan of £3,500 for the purchase of meters, and for free wiring for the ensuing three years.

Durham.—The C.C. has questioned 108 local authorities on the proposed county electric supply scheme, and of these 77 have replied in favour of considering the matter and 31 against. The Committee has recommended the Council to engage an expert to report upon the practicability of the scheme.

Edmonton. — At a recent meeting of the D.C., a committee presented a report with respect to an interview with Mr. R. Hammond, who had been appointed consulting engineer in the matter of electric lighting. Mr. Hammond advised the Committee that an offer received from the North Metropolitan Electric Power Co. to supply light and power, was a very favourable one. The company offered to lease the prov. order for 26 years, recoup the Council for all out-of-pocket expenses, and find the whole of the money necessary to give a supply on a sliding scale of 7d. for the first 100 hours per quarter, and 1½d. for all beyond that. If the Council accepted those terms, Mr. Hammond thought it would be essential to provide for a periodical revision of the prices, and to induce the company to put down a system that would be economical for the Council to work, when it came to purchase it. On Mr. Hammond's advice it was agreed to invite further offers from companies either to supply in bulk, or to work the undertaking provided the Council installed it, at a rent equivalent to the interest and sinking fund charges, the Council to have power to purchase at the end of seven years at a premium of 12 per cent, at the end of 10 years at 7½ per cent. premium, and at 15 years without any premium.

Germany.—Work is about to be commenced on the establishment of a municipal central electric lighting station in the town of Hohenmölsen.

Glasgow.—The results of the working of the electricity department show a surplus of over £10,000 on the past year's operations. The gross revenue amounted to £158,190, and the working expenditure to £61,738, out of which the Committee had to meet the interest on loans, £36,023, and sinking fund, £15,205, leaving a balance on the year's working of £45,222. From that there was deducted the proportion of cost of lamps and fittings supplied to consumers, consequent on change of voltage, charged to this year's revenue account, £2,700, showing a net balance of revenue over expenditure of £42,522. The Committee resolved to write off depreciation at the same rates per cent. as last year, amounting to £32,181, leaving a surplus on the year's operations of £10,341. The Committee during the year just closed, repaid to the gas department the amount at debit of the previous year's account, amounting to £13,895. The surplus on the operations of the year 1903-4 is £10,341, so that there is a balance of £3,554, which the Committee has decided to carry forward to the debit of the next year's accounts. The capital expenditure during the year just closed amounts to £109,482, and the total capital expenditure from the starting of the department in 1892, to May 31st, 1904, amounts to £1,119,047.

Haywards Heath.—The U.D.C. has decided to apply for a prov. order.

Isle of Thanet.—The local E.L. Co. has abolished meter rents, and the directors are considering the advisability of adopting a flat rate of 4½d. per unit, instead of the present maximum demand rate of 6d. and 3d.

Keighley.—On July 27th a L.G.B. inquiry was held into the application of the T.C. for a loan of £11,500 for extensions at the electricity works. There was no opposition.

Kingston.—The T.C. has authorised the erection of six transformer pillars, &c., at an estimated cost of £150 each.

Kingstown.—The B. of T. has written informing the Urban Council that it has cancelled the Council's electric lighting order. Expenditure upwards of £2,000 has already been incurred in connection with this order.

London.—LAMBETH.—The B.C. has had prepared a return, showing the average charges made to electric lighting companies, &c., by metropolitan boroughs for the reinstatement of trenches to be as follows:—York stone relaid, per yard super, 1s. 8·64d.; new York stone, 10s. 0·82d.; new Victoria stone, 8s. 10·71d.; tar paving relaid, 4s. 0·76d.; asphalte footway, 8s. 6·31d.; asphalte carriageway, 14s. 3d.; kerb refix, per foot lineal, 2·61d.; kerb refix on concrete, 7d.; new kerb on concrete, 2s. 7·52d.; pitched carriageway relaid per yard super, 2s. 4·88d.; pitched carriageway relaid on concrete, 4s. 10·66d.; new pitched carriageway, 15s. 10·83d.; macadam, 2s. 2·30d.; ballast or flints, 1s. 6·35d.; concrete, per yard cube, 17s. 2·25d.; wood relaid, per yard super, 15s. 11·4d.; brick paving relaid, 3s. 5·75d.; new paving bricks, per 100 bricks, 13s. 8d.; new boxes each, 9s. 9d.; holes cut, 1s. 7·75d.

The official auditor, in his report on the accounts of the South London Electric Supply Corporation for the past year, states that the overcharge which he disallowed in the accounts for 1900, of £2,275 to capital for directors' fees, has not been corrected. He also certifies that the capital expenditure to December 31st, 1903, amounted to £321,319, and states that, before a dividend was paid, the expenses of the flotation of the company, amounting to £46,649, should have been written off, and that a much larger provision should have been made for depreciation.

Longton.—The T.C. has adopted a system of motor hiring, and an agreement has been entered into with the British Thomson-Houston Co. for the supply of motors.

Provisional Orders.—Messrs. T. Hooley, Ltd., of Sandiacre, has informed the Shardlow R.D.C. that it proposes to apply for a prov order to establish a generating station at Sandiacre. The Southern District Electricity Corporation and Mr. G. V. Fowler intend to apply for an order for Newhaven. Three companies have informed the Ripon T.C. that they intend applying for a prov. order for the district, and the Power and Traction Co. is applying to have the E.L. order of the T.C. cancelled. The County of Durham E.P.D. Co. is to apply for an order for Durham R.D.C. The Stoke-on-Trent T.C. has been notified by Mr. G. V. Fowler that he will apply for an E.L. order for the town, and the Corporation has resolved to oppose the application. The Stone U.D.C. will oppose the granting of an order to the Southern District Electricity Corporation for its district. The Rhymney and Aber Gas and Water Co. has informed the Caerphilly U.D.C. that it will oppose the application for a prov. order for E.L. The Fenton U.D.C. will oppose Mr. G. V. Fowler's application to light its district.

Retford.—The T.C. has engaged Mr. A. B. Mountain, of Huddersfield, to report on an electric lighting scheme for the borough.

Sheffield.—The E.L. Committee has recommended the following reductions in the price of energy as from December 26th next:—Power (motors driving hoists, cranes, passenger lifts and similar machinery), 2d. per unit; other motors, 1½d. per unit; for continuous running motors through the working hours of each day with an annual consumption of not exceeding 5,000 units, 1½d. per unit; ditto exceeding 5,000 units, 1d. per unit; discounts are to be allowed of 5 per cent. on 10,000 units consumption, and up to 40 per cent. on a consumption of 750,000 units.

Stourbridge.—The U.D.C. has resolved to apply for a prov. order to extend the area of lighting to parishes within the district of the R.D.C.

Switzerland.—The municipal authorities of Trient have decided on the establishment of a central electric lighting station at an estimated cost of £120,000.

Tamworth.—The R.D.C. has decided not to assent to the application of the Corporation for a prov. order enabling it to supply energy to the parishes of Wigginton, Eblehall, and Glascote.

Tottenham.—The Special Electricity Committee reported to the D.C. that, whilst prepared to recommend the Council to adopt a scheme submitted by the Council's engineer for public lighting by utilising the power from the refuse destructor, it was of opinion that it was advisable to await the result of the Electricity Supply Bill now before Parliament, and to ascertain whether neighbouring local authorities would be willing to join in a general scheme under the Bill for the supply of electricity. It recommended that, in the meantime, advertisements should be issued inviting offers for the supply of electricity in bulk or otherwise.

Wanstead.—The Empire Electric Light and Power Co. has informed the U.D.C. that it intends applying to the B. of T. for a prov. order for electric lighting in the district.

Wolverhampton.—A L.G.B. inquiry was held on 28th ult. into the application by the Corporation for power to borrow £13,000 for E.L. purposes. The town clerk explained that £3,000 of the total sum was required for the provision of electric generating plant at the new refuse destructor; £2,800 for mains to connect up to the existing network to enable the Corporation to supply the large manufacturing district in the vicinity of the destructor; and the balance, £7,200, for the extension of mains throughout the borough. There was no opposition.

TRAMWAY AND RAILWAY NOTES.

Aberavon.—Mr. Lewis (of the firm of Messrs. Lewis and Fletcher, electrical engineers, Cardiff) attended a recent meeting of the T.C., on behalf of the syndicate which is promoting a scheme for the construction of an electric tramway from Briton Ferry to the sea beach at Aberavon. Mr. Lewis stated there would be a connection with the Neath trams at Briton Ferry, but the syndicate would not have running powers over the Neath lines. Two-thirds of the proposed line would be within the Aberavon area. The Council approved of the scheme subject to satisfactory terms and route.

Barry Railway and Electric Traction.—The directors of this line report that the question of the electrification has been carefully considered. A committee went to the Continent and inspected certain railways and works which are worked by electrical power. After considering the report of the Committee and officers, based upon a thorough investigation of those lines and works on the Continent which they inspected, the directors are of opinion that, under present conditions, the application of electrical power to railways which deal with a heavy mineral traffic is impracticable. The directors are of opinion that the passenger traffic on certain portions of the railways will be more economically worked by the limited use of motor-coaches.

Brooklyn, N.Y.—A New York correspondent writes:—"The Allis-Chalmers Co., of New York and Chicago, has secured a contract to supply electrical machinery, aggregating 100,000 H.P., to the Brooklyn Rapid Transit Co., at an estimated total of $2,000,000 (£412,371). This is a triumph for turbine-driven machinery, and for the Allis-Chalmers Co., which has only recently entered the electrical field in spirited competition with the General Electric and the Westinghouse Companies. The first specifications call for the provision of six 5,500-KW. turbine dynamos, to be directly connected with 25-cycle, 750 r.p.m, three-phase alternating generators, to be wound so as to give either 6,000 or 11,000 volts. These engines are to be installed in the new power house of the B.R.T. Co. now building on Kent Avenue. When completed, this power house will have a total capacity of 100,000 H.P., and its equipment will include 12 5,500-KW. generators. This machinery will be used to drive the surface and elevated cars in the borough of Brooklyn, both of the B.R.T. and its dependent companies. A portion of the Allis-Chalmers equipment is to be tested in comparison with similar dynamos furnished by the General Electric Co., already under contract."

Colchester.—On Thursday, July 28th, the electric tramway system was formally opened, the Mayor starting the first car. The length of the lines is about 5¼ miles. After the opening, Councillor Marshall, the chairman of the Tramways Committee, presided at a luncheon given in the Grand Jury Room. The toast of "The Contractors" was responded to by Mr. A. N. Connett, on behalf of Messrs. J. G. White & Co., Ltd., and Mr. H. Scholey, on behalf of Messrs. Dick, Kerr & Co., Ltd. Mr. Connett subsequently, on behalf of Messrs. White, presented the Mayoress with a handsome silver bowl in commemoration of the event. The plans and specifications for the permanent way were carried through by the borough engineeer, Mr. H. Goodyear. The electrical equipment was designed by Mr. A. R. Sillar. Mr. R. C. Bullough is the general manager and engineer of the system under the Corporation.

East Ham.—The gross receipts of the municipal electric tramways for the year were £35,301. The working expenses came to £25,212, repayment of loans, £4,260, and interest, £4,855. Of the balance, £592 is to go to pay initial expenses, and the remainder (£379) will be put to reserve.

The Electrification of the Metropolitan Railway.—In the course of his speech to the half-yearly meeting of shareholders, Sir C. B. McLaren, Bart., M.P. (chairman), said: Some of the turbo-generating machinery had been delivered at Neasden, and in a few weeks' time experimental tests would be made. The cables and the conductor rails had been laid, and the general equipment of the permanent way had been completed from Baker Street to Uxbridge, and similar work was now being prosecuted each night upon the Inner Circle section, and would soon be completed. A number of sub-stations had been built, and the rotary converters and transforming machinery had been installed in most of them. They had had built in England a first consignment of 70 cars, all of which had been completed, and, with one or two exceptions, delivered at the company's works at Neasden. It was his intention, together with one or two of the principal officers of the company, to pay a visit to America before the end of the year, to look very carefully into the methods of the working of some of the electric railways there, with a view to getting some hints which would be of service to them when they commenced to work by electricity, which they believed would be at the end of the year.

Germany.—The employment of horses for hauling tramcars has now almost entirely ceased throughout Germany. This fact is illustrated by the statistics, belated as they are, which have just been issued in Berlin in reference to the electric tramways in operation in that country in October last, and which would indicate various additions if brought down to the present time. The statistics show that in the month in question the total length of tramways worked by horse traction had diminished to 32 miles, whereas the electric tramways in operation represented a route mileage of 3,410 miles, served by 8,702 motor-cars, and 6,190 trailing-cars. This mileage is distributed over 134 towns, and is almost exclusively worked on the overhead trolley system. In Berlin, Dresden, and Dusseldorf, short sections of lines are operated on the underground conduit system in a similar manner to the London County Council tramways, while accumulator cars are only employed in two localities, and will probably soon be discontinued.

Great Eastern Railway and Electric Traction.—At the recent half-yearly general meeting, Lord Claud Hamilton referred to the competition of new railways which ought never to have been made, and which, by charging ridiculously low fares, were not only a loss to their own shareholders, but also inflicted serious injury upon existing lines by compelling them to reduce their fares to an almost unremunerative figure. There was the Great Northern and City Railway, which had been open for six months and barely paid its working expenses. The effect of this competition on the Great Northern, the North London, and the Great Eastern Railways was that each of them had had to reduce their fares on the portions of their respective lines that ran in competition with it. And yet this line, which was constructed to deal with excess traffic to and from the City and suburbs, was so overcrowded at certain portions of the day that there was hardly seating accommodation for the travelling public, while in the middle of the day these trains were running comparatively empty. The Whitechapel and Bow Railway was another railway which had about it elements of a speculative character. In regard to electrical traction they had thought it advisable not to undertake new schemes for the present. They were watching the development of that portion of the Lancashire and Yorkshire Railway between Liverpool and Southport, and he, together with the general manager and five other principal officers of the company, had recently visited France to see whether there was anything to be learnt in regard to the working of the French railways. They had come back thoroughly satisfied that there was nothing in what they had seen—though a great deal that was commendable—that would prove of use to the Great Eastern Railway. They were, therefore, continuing the policy of holding their hands until they found something which they could recommend with full confidence. They had started a service of road motor-cars between Lowestoft and Southwold. He understood that they were well patronised and gave satisfaction to the public. They had also started an accelerated service of trains between Ipswich and Felixstowe on the same principle as that run by the Great Western with motor-cars in the Stroud Valley. In both cases it was too soon yet to pronounce upon the ultimate success of the experiments.

Hythe (Kent).—The B.E.T. Co. has placed before the T.C. a scheme for the establishment of an electric tramway between the town and Folkestone, on the overhead system. The Council has decided to support the scheme, and a similar step has been taken by the Sandgate U.D.C.

Metropolitan District Railway and Electric Traction.—The report for the half-year ended June 30th says that the zone fare system (authorised by the Act of this session), will come into operation on the electrification of the railway. The work of electrification is making rapid and successful progress. The power station at Lots Road, Chelsea, is virtually completed, and the machinery is being installed. The sub-stations on the company's lines are nearing completion. Four hundred and twenty new corridor cars, providing 60 trains, have been ordered and are being constructed. Many miles of cables have been drawn into the ducts. The litigation which has been going on for several years between the company and the Metropolitan Railway Co. with reference to the division of traffic and the user of the Western joint lines has been brought to an end, an arrangement having been made which is believed to be mutually satisfactory. The working agreement between the two companies has been extended until such time as the railways are worked electrically, and the company receive 57 per cent., instead of 50 per cent., of the pooled receipts, in addition to a payment for arrears.

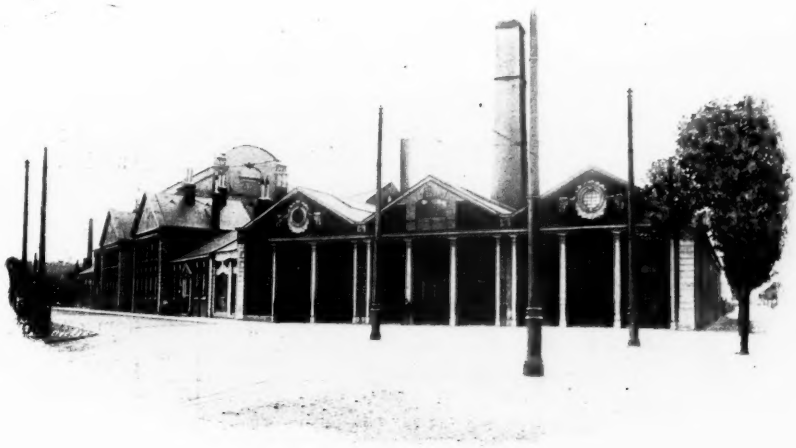
Manchester.—A bogie car, while travelling at high speed down a slight decline on the Bury Old Road, on July 27th, collided with a smaller car which was just entering a loop from the opposite direction. Both cars were full at the time and a number of passengers were injured.

North Wales.—An inquiry was held at Corwen on Friday by the Light Railway Commissioners relative to the application for powers to construct an electric railway from Corwen to Bettws-y-Coed, and Penmachno, a distance of 28½ miles, on the overhead system. The scheme was supported by Lord Penrhyn and a number of local authorities. Opposition was offered on behalf of the Hon. C. H. Wynn, it being contended that that gentleman's estate would be damaged.

(*Continued on page* 223.)

IPSWICH ELECTRIC LIGHTING AND TRAMWAYS UNDERTAKING.

The history of the Ipswich electric lighting and tramways undertaking covers a period of 10 years, although the generating plant and the first sections of the tramways were only opened as recently as November last.



View of Generating Station and Car-Shed.

Whether this long hesitation can be ascribed to extreme caution or to the ingrained conservatism of the inhabitants, or to a flourishing gas company, we cannot say, but it will be some consolation to the ratepayers to reflect on the accumulated experience of other places that is embodied in their venture, which, under the able supervision of Messrs. Kennedy & Jenkin, the Corporation's consulting engineers, is, we feel sure, well equipped for the purposes for which it is intended.

The site chosen for the generating station and destructor buildings and car-shed is at one corner of a piece of land known as the Seven Acre field.

Ample space is left for future developments, and the Great Eastern Railway, from which a coal siding has been constructed, and the River Gipping from which the condensing water is obtained, are close at hand.

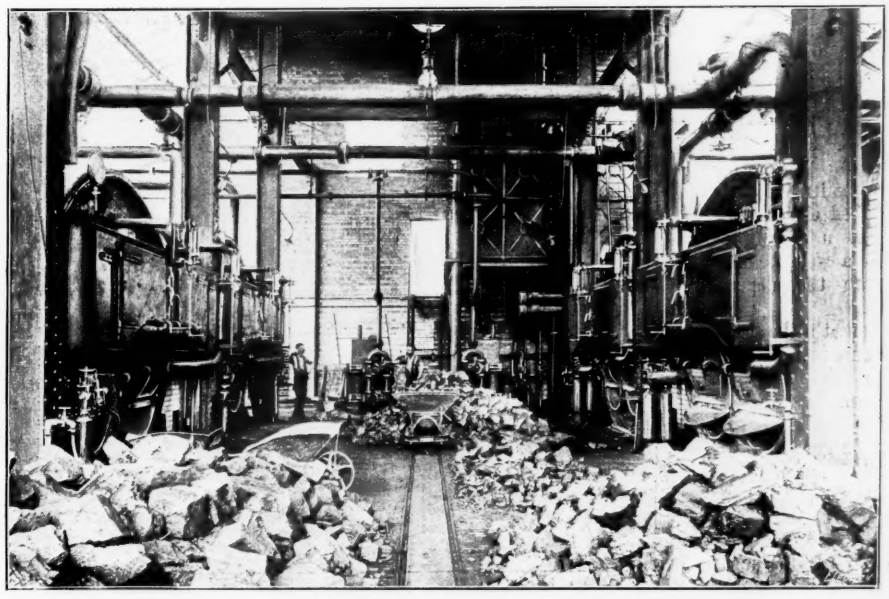
The buildings are constructed in red brick, to the designs of Mr. C. Stanley Peach, F.R.I.B.A., and consist of an engine, boiler and battery rooms, and a car-shed with a workshop, opening both into it and the engine room; handsome suites of offices for both the tramways and lighting departments are arranged on either side of the main entrance in Constantine Road.

The boiler-house plant at present consists of four boilers of the dry-back marine type, 11 ft. 6 in. in diameter and 14 ft. long, and space is available for four more. The boilers were supplied by Messrs. E. Danks & Sons, Birmingham, and are each rated to evaporate 11,500 lbs. water per hour, with a working pressure of 160 lbs. per sq. in.

The boiler fittings are of Dewrance's well-known make, the boiler steam branches being fitted with non-return and stop valves.

In connection with the boilers, a Lowcock economiser of 168 tubes is installed, driven by a small horizontal steam engine; this plant is arranged so that it can be quadrupled in the present building. The chimney, which also serves for the refuse destructor, is 175 ft. high and 12 ft. sq. internally.

Fuel for the boilers is obtained from the railway siding previously mentioned and transferred into the boiler house by means of small dumping cars; this arrangement, however, is only temporary, as it is intended to add coal bunkers over the boiler house and to equip the building with suitable conveyors.



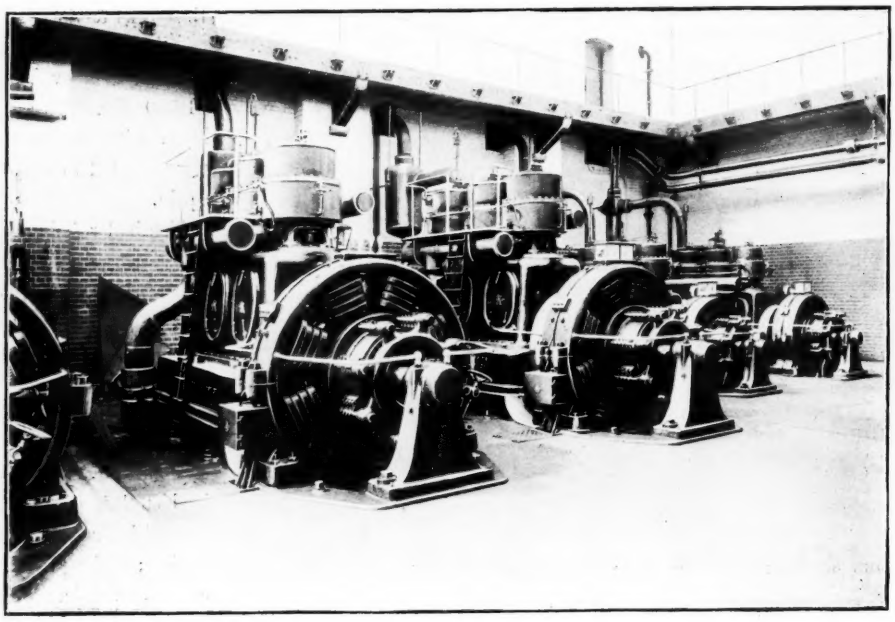
View of Boiler House, also showing Feed and Hot-well Tank.

The refuse destructor is one of Meldrum's Simplex type, and is situated some distance from the other buildings; it is designed to burn 40 tons per 24 hours, and is combined with a Lancashire boiler, 8 ft. diameter

and 30 ft. long, constructed for a working pressure of 200 lbs. per sq. in.

The guarantee for the combined plant was 1 lb. of refuse to evaporate 1 lb. water at 60° F. into steam at 200 lbs. pressure.

A 6-in. steam pipe from the destructor plant connects through a reducing valve, with the steam range in the boiler house; a bye-pass is fitted to enable steam from either side to be used for warming up pipes, or starting up the destructor blowers, as the case may be.



View of Lighting and Traction Generating Sets.

Returning to the boiler house, at one end is situated a feed and hot well tank, 18 ft. × 8 ft. × 9 ft., supplied by water which has been returned from the condensing plant in the engine room, and passed through a Paterson oil filter situated immediately over the tank. The make-up water for this boiler feed is obtained either from the town supply or from a well belonging to the department.

Beneath the feed-tank are installed two Weir feed-pumps, the smaller one of 1,500 gallons, and the larger a compound pump of 6,000 gallons per hour capacity. The pumps are arranged to feed through Kennedy water meters, and either direct or through the economiser to the boilers, the feed range being in duplicate.

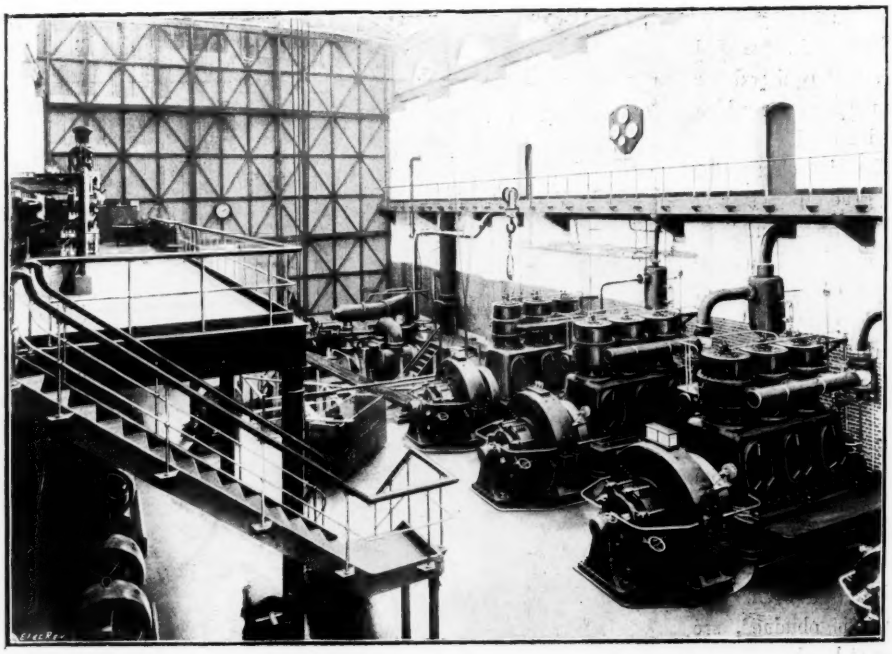
The steam piping is constructed of wrought welded steel, there being two main headers, 7 in. and 10 in. diameter respectively, each fed independently from the boilers. The whole of the valve work, with the exception of that supplied with the boilers, is of Hopkinson's well-known make.

Separators are provided on the main steam pipes, and on each engine branch; these are emptied through Geipel steam traps, into a drain leading to a clean drain tank, which can be emptied as required by means of the feed pumps, to which a suction branch is provided.

A dirty water sump is provided in the engine room, and is emptied by means of an automatic motor-driven centrifugal pump.

The engine room is a well lighted lofty building, and is spanned by a 15-ton travelling crane, supplied by Messrs. Ransomes & Rapier, of Ipswich, and worked by means of ropes from the floor.

The plant installed in the engine room comprises three 360-H.P. and two 200-H.P. high-speed generating sets, in which the engines are of Messrs. Reavell's three-crank compound type, direct-coupled to continuous-current generators supplied by the Electrical Co., Ltd. These machines are eight-polar, compound wound in the case of the larger lighting and traction sets, and shunt-wound for the smaller sets which are intended for lighting only; their outputs and speeds are, respectively, 240 KW. at 350 r.p.m., and 120 KW. at 450 r.p.m. They are designed to take a 25 per cent. overload for one hour.



General View of Engine Room, showing also Condensing Plant.

The foundations for a further engine and generator are being put down at the present time, and the set, which will be a similar combination to those at present installed, is rated at 790 H.P. and 500 KW. Space only remains in the

present building for one more generating set and the condensing plant.

In addition to the plant previously mentioned, there are installed in the engine room two balancers, each consisting of a two-crank Reavell high-speed engine, with a 24-KW. shunt-wound generator of the Electrical Co.'s make coupled to each end of the crankshaft, the speed of the combination being 450 r.p.m.; two 20-KW. boosters by the same makers, and a small milking booster for use in connection with the battery.

The first section of the condensing plant, to deal with 33,000 lbs. of steam per hour has just been installed; it is of normal surface condensing pattern, with compound steam-driven Edwards air-pumps, and a motor-driven centrifugal circulating pump, the motor being rated at 18 H.P., and of Westinghouse type. An additional pump is fitted in connection with the air-pumps, for the purpose of lifting the hot-well water to the oil filter over the feed tank previously mentioned.

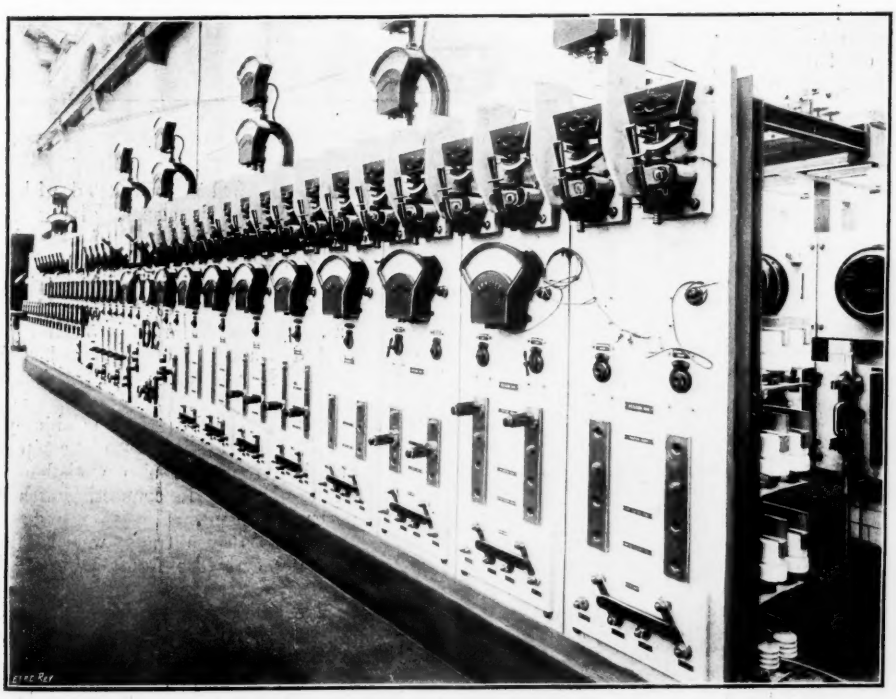
As a precaution against failure of the condensing plant, a 21-in. atmospheric exhaust pipe is provided, connected to the exhaust steam main through an automatic valve. The condensing plant was manufactured by Messrs. Bertrams, Ltd., and supplied through the Sir Hiram Maxim Electrical and Engineering Co., the contractors for the whole of the steam, exhaust, feed and drain piping and condensing plant.

The circulating water is drawn from the River Gipping, from which it flows into a well adjacent to the engine room, and passes to the condensing plant through 16-in. diameter suction-pipes; the condenser discharge is through 24-in. diameter pipes, returning to the river at some distance from the intake.

On one side of the engine room is situated a battery room containing 124 cells, having a discharge of 280 amperes for 1 hour, or 100 amperes for 4 hours. This battery is used in connection with the light and power supply, and was made by the Tudor Co.

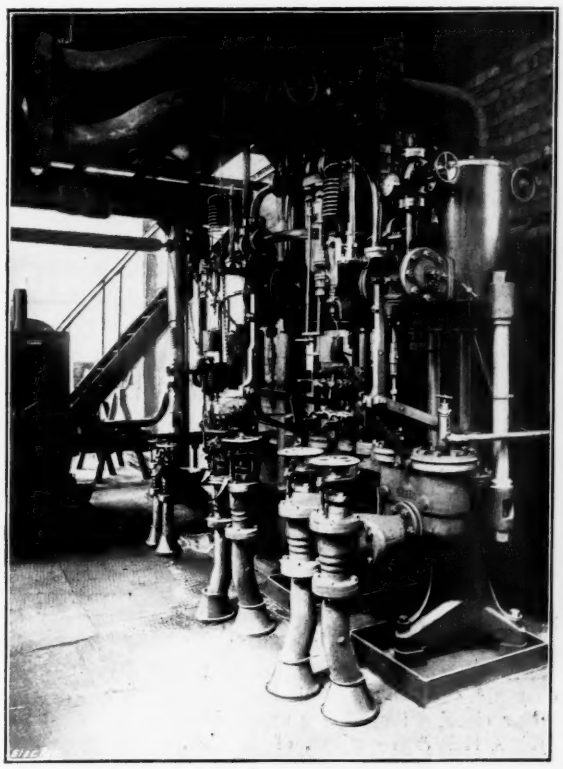
A wide switchboard gallery runs down one side of the engine room, and a continuation round to the opposite side is intended for a pipe gallery.

The main switchboard is constructed of white marble panels, and was supplied by the Electrical Co., Ltd. Some



Main Lighting and Traction Switchboard.

23 panels are at present installed, comprising nine lighting and traction feeder panels fitted with knife switches and ammeters in the case of the lighting, and with circuit breakers and ammeters in the case of the traction panels. The ninth feeder panel is also equipped with earth current and recording ammeters and rail drop recording voltmeter, &c.



Weir Feed Pumps.

One panel is provided with the usual Board of Trade instruments; two panels for the battery boosters, three battery panels—positive, neutral and negative—four balancer panels, two main lighting and two main lighting and traction generator panels complete the principal board, behind which ample space is allowed for repairs and alterations.

The main dynamo fuses and the meters for recording the total outputs of the dynamos are all arranged on subsidiary panels fixed against the wall at the back of the main switchboard. The feeders from the various points on the tramways and on the lighting distributing network are brought into the station through a tunnel which runs under the north end of the battery room. In this tunnel the cables are supported on porcelain insulators, these in turn being attached to an iron framing. At the point where the cables enter the basement of the engine room they are carried up the wall to the back of the switchboard, being supported

by special cleats in this position. The cables from the switchboard to the dynamos are taken down the same

Cornhill, Ipswich, showing Type of Side Bracket in use on Tramways.

wall, and into the pits under the dynamos by way of the engine room basement.

At one end of the main switchboard are situated two subsidiary boards for controlling the station lighting and power circuits, these being supplied by Messrs. Hall & Hackblock, of Ipswich. A small switch panel for controlling the milking booster is arranged adjacent to the latter, under the gallery.

The station lighting consists of ten 1-ampere Nernst lamps, sundry incandescents and an arc lamp in the boiler house, this also being carried out by the local firm.

Turning to the tramways, in connection with which a handsome car-shed and workshop have been constructed adjoining the station buildings, there are some 10½ miles of route in operation, principally single line with turn-outs, constructed to a 3 ft. 6 in. gauge.

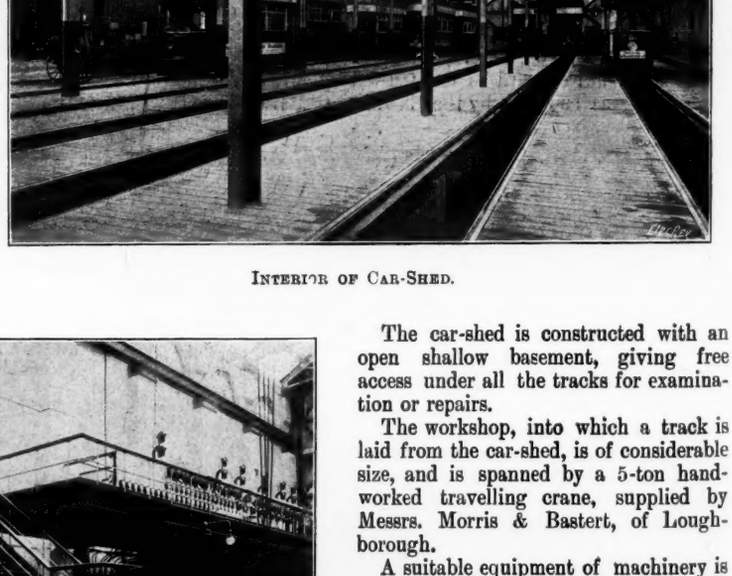
View of Steam-Balancers, Boosters and Auxiliary Switchboards.

The track construction is of the normal type, 6½-in. rails, weighing 90 lbs. to the yard, being employed, laid on a concrete bed, 6 in. deep, and for the greater part the track and margins are paved with granite setts; in the centre of the town the paving is of wood, normal with the rest of the road surface. Messrs. Dick, Kerr & Co. were the contractors for the track work.

The overhead equipment is arranged with side arm and span wire construction, double trolley wire being used throughout. This, together with the sectional pillars, which are of the usual type, but with a small telephone box mounted above, was supplied by the British Electrical Equipment Co.

The cars are 26 in number, of the single-truck double-deck type, with a seating capacity of 50 passengers, 24 inside and 26 outside. The British Westinghouse Co. were the contractors, and supplied the whole of the electrical equipment, which includes two 30-H.P. motors per car.

As sub-contractors, the Brush Electrical Engineering Co. supplied the car bodies and trucks, the latter being of their standard type, with steel-tired wheels. The cars are fitted with electrical wheel and slipper brakes, the latter being arranged on the Brush pattern, with concentric spindle gear.



Interior of Car-Shed.

The car-shed is constructed with an open shallow basement, giving free access under all the tracks for examination or repairs.

The workshop, into which a track is laid from the car-shed, is of considerable size, and is spanned by a 5-ton hand-worked travelling crane, supplied by Messrs. Morris & Bastert, of Loughborough.

A suitable equipment of machinery is provided for dealing with car repairs, and is, of course, also available for any repair work in connection with the generating plant.

A motor-driven track watering and brushing cart also forms part of the tramway department.

The cable work in connection with both the lighting and traction undertakings has been carried out by Messrs. Johnson & Phillips, the system adopted being paper-insulated, lead-covered cables, laid solid in wood troughing.

Seven tramway feeders, three ·1, three ·15, and one ·2 sq. in. section, have been laid; the lighting feeders are mostly ·3 sq. in. concentric cables, and the distributors are

uniformly, positive ·12, middle ·06, and negative ·12 sq. in. area.

Turning to the progress which has characterised the first nine months of working, it is satisfactory to record that some 21,000 equivalent 8-c.p. lamps have been applied for, and that many more are in view. Included in the above amount is over 200 H.P. of motors, from which it will be evident that many Ipswichians have appreciated the great benefits of electrical driving, and with a 16 per cent. load factor thus early in its history, we look forward confidently to a record progress of the undertaking.

In conclusion, we beg to express our indebtedness to the chief engineer and manager, Mr. Frank Ayton, and to those of his staff who so kindly assisted us in the preparation of this description.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 218.)

Liverpool.—A report of the auditors to the City Council (Messrs. Lewis and Mounsey) which has just been issued, contains a special reference to the tramways undertaking. The income for the year reported on is shown to have been £531,483, the net increase over the preceding year being £16,406. An amount of £190,020 was carried to the net revenue account for the year, as available for interest, sinking fund, rate aid, &c. The auditors express the opinion that the value of the assets on which depreciation was necessary did not exceed £900,000. The sum of £64,161, which was placed to reserve, renewal, and depreciation funds account, was equal to 7 per cent. on that sum, and was in operation in addition to the sinking fund. In the opinion of the city engineer, ample provision was being made for depreciation, having regard to the renewal, reserve, and sinking funds, and to the manner in which the property was being maintained out of revenue. The city engineer, the consulting electrical engineer, and the general manager have reported jointly on the permanent way and the overhead equipment of the tramways. They say that considerable benefit is expected to arise from the continuous welding of the rails. The life of portions of the heaviest traffic lines had exceeded the city engineer's original estimate, and it was probable that a life of 7½ to 10 years would be obtained. A steel-tired wheel was being finished at the Lambeth Road works, which would cost 50 per cent. less than the price at which such wheels could at present be bought, the life of which might be estimated at 60,000 miles, the average mileage of chilled wheels at Liverpool now being 35,000. With regard to electrical equipment, the system adopted had proved satisfactory in work. Alterations had been made in small matters of detail in the overhead fittings by which the durability of the parts had been increased and replacement facilitated with a reduction in the cost of maintenance.

Mandalay.—On July 2nd a service of electric tramways was formally inaugurated by the Lieutenant-Governor of Burma. The total length of the tramway is 6 miles of double track (3 ft. 6 in. gauge). Messrs. Dick, Kerr & Co. supplied the plant and carried out the work. Messrs. Kincaid, Waller, Manville & Dawson acted as consulting engineers. There are 24 cars.

Middlesex.—Consent was given by the County Council on July 28th to the Metropolitan Electric Tramways, Ltd., reconstructing and widening, at their own expense, Angel Bridge, Edmonton. The plans must be approved by the county engineer.

Intimation is to be given to the London United Tramways, Ltd., that tramways will be permitted over the Middlesex half of Kew Bridge, provided (*a*) that the company pay 3 per cent. per annum on one-third of the total cost of that portion of the bridge and its approach; (*b*) that the company maintain, repair, water, and scavenge the carriageway and footways; (*c*) that the company pay one-third the cost of all future structural repairs. A scheme for the proposed widening of Kingston Bridge, suggested on behalf of the London United Tramways, Ltd., was rejected, and it was decided to engage the services of an engineer to advise the Council on the question, and prepare a preliminary design.

New York City.—Our New York correspondent writes:—"The new power house of the InterboroughRapid Transit Co. at Eleventh Avenue and Fifty-ninth Street is approaching completion. The building is practically finished, and already three of the fifteen 12,000-H.P. generators are in position, and have been running in working order. The structure covers a space of 700 × 200 ft., and is of substantial and pleasing architecture. On July 20th it was inspected, together with a portion of the new subway, which is to be opened on September 1st, by Mayor MacClellan, Mr. August Belmont, the president of the Interborough Co., Mr. John B. MacDonald, the tunnel contractor, Mr. Alexander Orr, chairman of the Rapid Transit Commissioners, and a large number of civic officials and engineers."

South Shields.—A meeting of the Tramways Committee of the Corporation was held on the 28th ult. to consider the amended tender of the B.E.T. Co. Messrs. Rowecliffe had written, stating that under the conditions imposed by the Committee they were unable to submit an amended offer, and withdrawing their tender. The amended tender of the B.E.T. Co. offered, our correspondent understands, to find the whole of the capital required, and to construct and to work the tramways on a 42 years' lease, undertaking to hand back the lines in good working order at the expiration of the lease, free of cost, to take over the existing debt on the tramways, to seek powers to extend the lines to Harton, and to undertake to give running powers over the lines now under construction to Jarrow from the Corporation lines. Reports were submitted from various Corporation officials on the tender, and the grounds of objection were that:—(1) The lease was too long; (2) No adequate consideration was offered for the use of the streets; and (3) The price to be paid for energy was too low. On the other hand, it was pointed out that the acceptance of the tender would relieve the Corporation of any monetary risk, and would enable the existing system to be reconstructed for electrical working and the extensions to be made at once, instead of waiting for the termination of the present lease. Councillor W. E. O. Scott moved that the Tramway Committee should recommend the Council to regard the amended offer to construct as well as to lease as the basis for an agreement, and that the Council instruct the Committee to settle the details of the agreement by conference with the company in accordance with the officials' criticisms. This was eventually agreed to. Councillor Wylie has given notice to move at the next Council meeting that the resolution giving full powers to the Committee to obtain the best tenders be rescinded, and that the Council carry out a scheme of its own.

TELEGRAPH AND TELEPHONE NOTES.

Ilford Telephones.—The U.D.C. is considering the advisability of installing a system of municipal telephones for the town.

Underground Telegraphs.—Lord Stanley stated the other day that the pipes in the underground system of telegraphic cables to the North have been laid as far as Carlisle, and also over the Beattock incline. Wires in the pipes have been provided as far as Liverpool, Manchester, and Leeds, and are now being provided in the Warrington-Carlisle section. The original section—viz., that between London and Birmingham—traversed the area which had suffered especially through storms in former years.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
Dominica-Martinique	May 9, 1902	..
St. Lucia-Martinique	May 9, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Dakar-Konakry	May 13, 1901	..
Chio-Ténédos	June 21, 1904	..
Paramaribo-Cayenne	July 13, 1904	..
Assab-Massowah	July 26, 1904	Aug. 2
Landlines.		
Seoul-Masampo	Feb. 18, 1904	..
Seoul-Gensan	Feb. 18, 1904	..
Anju-Ping-Yang	Feb. 25, 1904	..
Ninguta-Vladivostock	March 2, 1904	..
Moulmein-Bangkok	July 18, 1904	..
Rome-Constantinople	July 31, 1904	Aug. 2
Irkoutsk-Pekin	Aug. 2, 1904	..

Wireless Telegraphy.—Reuter reports from Washington that Mr. Roosevelt has approved the report of the Evans Commission, awarding the control of the Government's coastal system of wireless telegraphy to the Navy Department, on the ground that it is part of the country's defence, and of more importance to the Navy than to the Army, with the exception of those stations necessary for communication between army posts. The report recommends legislation to prevent private companies from interfering with the Government's coastal system.

A dispatch from Cettinge says that Signor Marconi, accompanied by the Marquis di Solari, has arrived at Antivari. "Wireless telegraphy between Bari and Antivari will be established within a few days."

Wireless Telegraphy in America.—The New York correspondent of the *Pall Mall Gazette* says:—"At present, the United States appears to be a favourite field for the promotion of wireless telegraph companies. The efforts to sell shares and bonds of these corporations during the last two or three years have rivalled the work of oil and gold-mining promoters. It is safe to say that the capital of the alleged wireless telegraph companies combined runs into millions of pounds, while the expenditure for advertising matter has been very great. Naturally, the Marconi Co. is most heard of, for its boomers are giving it more publicity than any of its rivals. Although three years have elapsed since the principal Marconi station was erected in America, at Glace Bay, on Cape Breton, the use of wireless service has been practically restricted to distances of not over 100 miles. Thus far, no service has been established which in any way competes with the ordinary telegraph or telephone system. Apparently there is as little possibility of competition at present from wireless telegraphy for general business purposes, as when it was first introduced into the United States. A suit has been begun in the Supreme Court of New York against the Marconi Co., asking that the corporation be placed in the hands of a receiver. The suit is brought by a shareholder named Gardner, who claims that the company is unable to pay its debts, and that its condition is such that it should be placed in the hands of the

Courts. The total amount of ordinary shares is placed at £1,200,000, but the petitioner claims that its assets are far less than this amount. The statement is made in the legal papers that a large portion of the money which has been paid for the shares of the company has been expended in advertising them for sale, and that the earnings are so small that they represent but little value."

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—August 10th. Tenders are being invited by the Belgium State Railway authorities at La Bourse, Brussels, for the supply and installation of the plant, &c., required for the electric lighting of the railway stations at Flenu-Central, Warquignies, Jemappes, and Quaregnon-Central.

Bermondsey.—August 8th. Wiring of staircases and courtyards of the Fulford Street Dwellings of the Council. See "Official Notices" July 29th.

Bulgaria.—August 13th. The Municipal Authorities of Phillippopolis are inviting tenders for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

Dublin.—August 23rd. 500 alternating-current meters. See "Official Notices" to-day.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" to-day.

Leeds.—August 15th. Two 1,000-KW. turbo-alternators with condensers, exciters, and high and low-tension switchgear. See "Official Notices" July 22nd.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Manchester. August 30th.—Wiring and electric lighting of transit sheds at the New Dock Works. See "Official Notices" July 29th.

Newcastle-on-Tyne.—The Tramways Committee on Monday last resolved to advertise for tenders for 20 new cars.

Penang.—August 16th. Steel rails, permanent way material, trolley poles, wire, feeder pillars, &c. See "Official Notices" July 29th.

Perth.—August 16th. $4\frac{3}{4}$ miles of tramways for the Corporation: permanent way, paving, and bonding, overhead equipment, cables, ducts, &c., cars and equipments, car depôt building. See "Official Notices" July 22nd.

Plymouth.—August 15th. (1) Steam alternator; (2) Lancashire boilers with accessories. See "Official Notices" July 15th.

Santos (Brazil).—August 20th. Power house plant consisting of producer gas plant and gas-driven alternators of a total of 400 KW., and transformers. See "Official Notices" July 22nd.

Wakefield.—August 15th. The Wakefield and District Light Railway Co. is inviting tenders for stores, tools, &c., for one year. See "Official Notices" to-day.

Warrington.—August 16th. Cables and stoneware conduits for the Corporation. See "Official Notices" to-day.

CLOSED.

Ashton-under-Lyne.—The B.G. has accepted the tender of Mr. G. H. Coop, electrical engineer, of Ashton, for an installation of telephones at the new hospitals and nurses' home, at £198.

Bromley (Kent).—The T.C. has accepted the tender of Messrs. Godfrey & Co., for the electrical installation at the refuse destructor works, at £634.

Clyde.—The Trustees of the Clyde Navigation have accepted the tender of Messrs. Stothert & Pitt, Ltd., Bath, for six electric cranes for the outer basin of Clydebank Dock.

Halifax.—The Corporation has accepted the tender of the Sloan Electrical Co., Ltd., for the supply of 10,000 pairs of arc lamp carbons, Conradty "C" quality, at the price of £3 16s. 5d. per 1,000 pairs.

Horwich.—The U.D.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for the supply of cables.

Islington.—The B.C. has received the following tenders for the supply of tail rods for three 1,000-H P. engines at the electric lighting station:—

Musgrave & Co., Bolton	£486	17	0
Wailes & Co., Euston Road	388	0	0
Coombe, Barbour & Co., Belfast	370	0	0
Goodwin & Co., Southwark	315	0	0
D. Adamson & Co., Manchester	298	9	0
Richardsons, Westgarth & Co., Hartlepool	248	0	0
Cook & Co., Manchester	245	0	0
Renshaw & Co., Stoke-on-Trent	229	0	0
W. J. Oakley, 9, Walbrook, E.C. (recommended)	210	0	0

The Electric Lighting Committee has provisionally accepted the tender of Messrs. W. R. Renshaw & Co., Stoke-on-Trent, for the hire of 50 coal wagons at £7 5s. per wagon per annum, for a period of 5 years, and a *pro rata* charge for additional wagons, not exceeding 25, for use during the winter months.

Gloucester.—The T.C. has accepted the tender of Messrs. Mather & Platt, Ltd., for the supply of filtering plant at the electricity works, at £192.

Pietermaritzburg.—Messrs. Pollock & Macnab, Ltd., of Bredbury, Manchester, have received an order for machine tools for the Pietermaritzburg Corporation's car-shed.

FORTHCOMING EVENTS.

Saturday, August 6th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Annual General Meeting at Wood Memorial Hall, Newcastle.

Wednesday, August 17th to 24th.—At Cambridge. The Annual Meeting of the British Association for the Advancement of Science. President: Mr. A. J. Balfour, M.P. The titles of some of the papers to be read before the "Engineering Section," were given in our issue of July 29th.

NOTES.

The M.E.A.: A Complaint.—We have been asked to publish the following copy of a letter which has been addressed to the Secretary of the Municipal Electrical Association:—

"Dear Sir,—I am enclosing you cheque in payment of my subscription. Kindly accept this as my last, for the following reasons:—

"I, in common with others, joined the Municipal Electrical Association, believing, as stated, that the Association was for the binding together of municipal engineers for mutual help, and for the social advancement of same, both laudable objects *if carried out*.

"Without carping at the valuable papers that have been presented from time to time, and the work done by the Association, I am bound to ask what has the Association done for the social advancement of us as a body? Why, since the date of inauguration salaries paid in every department of the profession have gone lower and lower. Posts are advertised, and men are asked what they will accept, not what will be paid. Chief engineers are advertised for (Bray), and then, as a catch, the most likely man is offered £50 less (and accepted) than the amount stipulated. There is a case in point, and, as far as I know, no notice is taken of such flagrant cases by the Association promoted to protect our interests. While not wishing it to be in any sense 'A Workmen's Union,' it should, I think, make an effort to impress on committees the fact that the men they are engaging are miles above the workmen who are under their direction and worthy of their pay.

"It is practically impossible for the Association to carry out its duty if both employer and employed are mixed up. The interests of Chairmen of Committees and their engineers, for instance, are not identical as far as salaries are concerned. In the case, too, of the assistants, the time spent at the annual meeting is often out of their annual holiday, and at *their own expense*. In the case of the engineers and chairmen it certainly is not; the ratepayers have to foot the bill. I trust you will forward this protest to the right quarter.

"I am, yours, &c.,
"CHIEF ASSISTANT."

A Revived Power Project in Southern India.—Somebody or other has unearthed the report of the Commission over which Colonel Pennycuick presided in 1893, which concerned itself with the possibility of utilising the power from the Periyar river in the Madras Presidency. Situated nearly 350 miles from Madras, the Periyar Falls were some 70 miles from the nearest railway line. The power going to waste was magnificent. A minimum flow of 600 cb. ft. of water per second the whole year round, with an available fall of 1,200 ft, would yield 60,000 E H P. Prof. Unwin was unable to proceed to India to carry out investigations on the spot; instead, a pertinent and valuable monograph appeared in the addenda to the report over his signature. After advocating Girard turbines, or tangent wheels, in place of the Pelton wheels, which the Public Works Department favoured, Prof. Unwin referred to the cost of transporting machinery up country, and the cost of canals, pipes, and buildings, pointing out that this might be expected to vary between 80 and 160 rupees per horse power of the generating station. In concluding his remarks, he pointed out that "the problem of the Periyar is essentially a problem of finding an application for a very large quantity of power. The hydraulic part of the problem is the least doubtful and least difficult. The distance of the site of generating

the power from places where it can be easily applied is the most serious obstacle to be met." Prof. George Forbes, who was also consulted, proposed 5,000 H.P. two-phase units, with transmission at 30,000 or 40,000 volts, and a frequency of 50 cycles per second. Allowing for 30,000 as the specified voltage, Prof. Forbes estimated the capital expenditure per horse-power delivered at the works switchboard at £4, while, delivered in Madras at a 100 per cent. load factor, it would be increased to £34. The lower (and more probable) load factor of 25 per cent. at the Madras end would involve an initial capital expenditure of £12 3s. per H.P. Of the probable outlets for the power, Prof. Forbes suggested the lighting of Madura, Trichinopoly, and Madras. Factories, too, might be attracted to sites about 100 miles north of the generating station, and aluminium refining (concerning which the late Sir W. Roberts Austen also prepared an appendix to the report) might spring up. Electric power might also replace steam for the driving of the electric tramways in Madras, and the electric locomotive might be introduced upon the railway lines in the south of Madras.

One copy of this report was filed in London. Other copies have, in all probability, grown dusty in official pigeon-holes in India, and the disinterring of one or other of these has apparently occasioned the Madras Government's appointment of Major Lotbinière, R.E., to investigate the possibilities of the finding of a remunerative output for the unutilised power of the Periyar Falls. On the strength of Major Lotbinière's appointment, some of the Indian non-technical papers are painting (verbally, of course) pictures of "electricity on tap all over the Madras Presidency within a radius of some 300 miles from the source of generation"!!

The Electrical Installation at Yarrow & Co.'s Shipyard.—On July 27th a number of members of the Society of Engineers visited the shipbuilding and engineering works of Messrs. Yarrow & Co., at Poplar. Electrical driving has been adopted in the works, the main motive power being supplied by three Belliss & Morcom compound condensing engines, which drive three Parker dynamos direct, each dynamo being capable of an output of 430 amperes at 210 volts. Steam is supplied by three Lancashire boilers. Over the boiler house is a cast-iron tank in which is a Ledward evaporative condenser. The drainage from the main roofs is collected in the tank and is used for condensing purposes, an economy in the use of the town water thus being effected. Most of the machine tools in the various shops are of the latest pattern and are placed in groups, each line of shafting being driven by its own motor. The shafting is 3 in. in diameter and runs at 140 revolutions per minute. The larger machines which are not continuously at work are driven by independent motors. The shops are fitted throughout with electric travelling cranes made by Messrs. Adamson. The air-compressing machinery is also driven electrically, a very complete pneumatic system being laid down throughout the works. There are arrangements for delivering compressed air on board vessels in course of construction on the river bank. The principal tools are fitted with pneumatic hoists. There is also a complete installation of hydraulic plant, which has been specially designed for the construction of the Yarrow water-tube boiler. Electric lighting is partially used in the establishment, the current being produced by the same dynamos that supply power; the circuits, however, are kept separate. The shops are heated by steam which is taken from the main boilers, and the various departments are all in telephonic communication. These new works, which give employment to about 1,200 men, are of such capacity and so advantageously arranged that Messrs. Yarrow are enabled to carry out on the same premises nearly the whole of the operations connected with the building and engining of the vessels they construct.

Electricity Works Tables.—The following additional data have been received:—

LONDON.—ISLINGTON.—Voltage, 100, 200 and 400 v. Total capacity, 3,600 KW.; max. load, 2,255 KW. Battery, Tudor, 100 KW. Add feeders concentric, distributors triple-conc., B.I. & H. paper-insd. laid solid. Total capital outlay, £393,172. Pr. ltg., 87,067; pb. ltg., 8,688; motors, 7,000; total connections, 102,755, all in equiv. 8-C.P. lamps. Increase, 16 per cent. Prices charged, pr. ltg., 7d. and 4d., or 5d.; pb. ltg., 3½d.; power, 2d. to 1½d.; htg., 2d. Special daylight supply, 2d. per unit (two-rate meter). Units sold, 2,867,647. Ave. price obtd., 3·87d. Works costs, 1·74d.; total costs, 2·21d.

ST. PANCRAS.—Total capacity, 6,390 KW. Max. load, 3,193 KW. Total capital outlay, £460,368. Pr. ltg., 77,366 8-C.P.; pb. ltg., 8 arc; motors, 56 = 484 B.H.P.; total connections, 38,772 eq. 8-C.P. Increase, 15½ per cent. Price for pb. ltg., 3d. per unit inclusive. Units sold, 4,730,341. Ave. price obtd. (ex. pb. ltg.), 3·97d. Works costs, 1·209d.; total costs, 1·627d.

WOLVERHAMPTON.—Pr. ltg., 50,160 8-C.P.; pb ltg., 53 arc, 38 inc. = 963 8-C.P. Motors = 13,259 8-C.P.; total connections, 64,382 8-C.P. Increase, 18 per cent. Price for traction reduced to 1½d. Total units sold, 1,971,794. Ave. price obtd., 2·582d. Works costs, ·921d.; total costs, 1·735d.

The Junior Institution of Engineers.—This year's summer meeting is to be held in Germany, Düsseldorf being the first stopping place. On Saturday, August 13th, the Exhibition will be visited, and on Monday there will be an excursion to Oberhausen for viewing the works of the Gutehoffnungshutte (blast furnaces, steel works, &c.). The Benrather Crane Works will also be seen. On Tuesday the Elberfeld-Barmen mono-rail suspended railway is to be inspected in the morning, and in the afternoon the members proceed to Hanover for the purpose of visiting on the following day Messrs. Körting Bros.' works, the Hanover engine works, and the works of the Westinghouse Brake Co. Thursday morning will be spent at Hanover, and in the afternoon Berlin will be reached. Here, on Friday, the overhead and underground railway will be seen, including car-sheds, generating station, &c.; also the Charlottenburg electrical engineering works of Messrs. Siemens and Halske. Saturday, August 20th, will be spent in visiting the Mariendorf works of the Imperial Continental Gas Association, and the Royal Technical High School at Charlottenburg. The members leave Berlin on the Monday for Leipsic, remaining there till Wednesday, when they go on to Frankfurt-on-Main to visit on Thursday and Friday, by invitation of Mr. W. H. Lindley, M.I.C.E., the municipal works, with an excursion to Homburg. On Saturday, August 27th, the return journey to England will be made, to include the Rhine from Brebrich to Bonn.

Gas Explosions in Street Boxes.—In the House of Commons the other day Sir T. Dewar asked the Home Secretary whether his attention had been called to an accident in Regent Street on Thursday, the 21st ult., occasioned through gas escaping into a telegraph inspection chamber, and coming into contact with a leakage in an electric wire, and would he state whether any explosions arising through leakage of a similar character had been reported by the police during the last two years. Mr. Akers-Douglas, in reply, said that he was informed by the police that, so far as they were aware, there were, within the Metropolitan Police District, during the two years ended June 30th last, 21 explosions of a character similar to that mentioned in the question. The explosions resulted in injury to 11 persons and in the death of two horses.

A Melbourne Protest.—The *Sydney Daily Telegraph* for June 16th says:—"At a meeting recently held of all the principal electrical firms represented in Melbourne, it was unanimously agreed that a protest should be sent to the Minister for Railways against the selection of Mr. Bradford, an employé of the representatives of the Westinghouse Electric and Manufacturing Co., as an expert to advise the Government with regard to the installation of electric traction on the suburban railways of Melbourne. Apparently, no attention was paid to the protest, as it is learned that Mr. Bradford has been definitely appointed to the position."

Derby Technical College.—Derby T.C. has decided to fit up an electrical engineering laboratory at the Technical College at a cost of £570.

Appointments Vacant.—The Marylebone B.C. has decided to again advertise for an electrical engineer at £600 a year; lecturer in electrical engineering for West Ham Municipal Technical Institute (£200); junior demonstrator in engineering for Sunderland Technical College (£150).

Specific Volume of Superheated Steam.—According to Schmidt, Hirns' experiments on superheated steam may be put into a formula as follows:—

$$s_v = 0{\cdot}59276\ \frac{441{\cdot}4 + T}{P},$$

where P is the pressure in pounds per square inch, s_v is the volume in cubic feet per pound, and T is the temperature in degrees F. For metric units,

$$V\ P = 0{\cdot}004683\ (263 + T)$$

where V is the volume of 1 kg. in cubic metres, P = pressure in kg. per square centimetre, and T = temperature Centigrade.

The Influence of Frequency upon Electrolysis with an Alternating Current.—According to a paper read by MM. A. Brochet and J. Petit before the Académie des Sciences, the usual view that frequency exerts a considerable influence upon the electrolytic reactions given by an alternating current, and that the amount of the products recovered at the electrodes decreases greatly as the frequency rises, is not generally true. Frequency only plays a small part in the process in a few special cases, such as the dissolution of iron and platinum in potassium cyanide, and of lead in sulphuric acid. With nickel and cobalt, the effect of altering the frequency of the current is very conspicuously in the opposite direction to that which has hitherto been held to be the case. The authors' observations show that an alternating current exhibits special electrolytic properties which are quite different from those of a direct current.

Electrolytic Production of Caustic Alkali.—H. M. Granier has taken out a French patent for a process of making caustic alkali by electrolysis in which the formation of hypochlorites and chlorates is claimed to be prevented. The electrolysing vessel is provided with a diaphragm, and the anode consists of copper or of a copper alloy. The electrolyte is a solution of an alkaline chloride which becomes saturated with copper chloride. The chlorine that is evolved at the anode attacks the copper, forming more copper chloride in the state of powder; this is eventually removed, and treated with strong sulphuric acid to convert it into copper sulphate, while the hydrochloric acid simultaneously liberated is collected.

Electric Shock Fatality.—It is reported that a labourer at the Acklam Ironworks, named Alfred Jones, 27, was killed on July 28th. He was breaking iron ore, and a piece of ore got wedged in some timber. Whilst trying to remove it, he slipped, and, in attempting to save himself, grasped at an electric lamp. On the current being switched off, it was found that he was dead.

Attorney-General v. Urban Electric Supply Co.—In the Chancery Division of the High Court of Justice on Tuesday and Wednesday last, Mr. Justice Joyce heard a motion by the Attorney-General and the Weybridge Urban District Council to restrain the Urban Electric Supply Co., its officers, servants, contractors, workmen, or agents, from supplying electrical energy for their power station at Weybridge, beyond the area of the Urban District Council; and, further, to restrain the defendants from breaking up streets or parts of streets in the said urban district for the purpose of laying down electric cables, surface lines on distributing mains, to supply or transmit electrical energy outside the said urban district until judgement in the action had been given, or until further order.

On behalf of the plaintiffs, Mr. Hughes contended that what had been done by the defendants in supplying the Walton Urban District Council with energy was a breach of the provisional order.

Mr. Younger, K.C., appeared for the defendants, and contended that his clients had a right under the Act to supply Walton as a local authority having power to light its own district.

Mr. Justice Joyce in the result held that the plaintiffs were entitled to an injunction to restrain the defendants from, in or by the exercise or use of any powers conferred this order; or by means of lines or works laid down or erected under such powers, supplying energy outside the area of supply, and also making use of any powers conferred by the order for the purpose of supply.

The injunction, it was stated, would not issue until August 12th, and a number of steps to be taken by the defendants were referred to.

Belfast Corporation Tramways Bill.—This Bill came before the Unopposed Committee of the House of Commons on Wednesday. Mr. Cripps, of Messrs. Dyson & Co., the Parliamentary agents to the promoters, said that the purpose of the Bill was to empower the Corporation to construct tramways within the City of Belfast; there were no tramways outside the city. The promoters also took power to acquire, by agreement, the undertaking of the existing company. The Corporation would electrically equip the tramways, most of the existing lines being worked by horse traction. Up to the present time the company had not done anything in the way of electrifying their system. Mr. Minshall, the engineer to the scheme, submitted and explained to the Committee plans of the proposed tramways and tramway reconstruction. The preamble of the Bill was found proved, and the measure was ordered to proceed.

Naval Boilers.—The Committee appointed by the Lords Commissioners of the Admiralty, in September, 1900, have completed their investigations and experimental trials, and have furnished their report, which has been issued as a Parliamentary Paper. The Committee point out that in their reports of 1901 and 1902 they expressed the opinion that four different types of water-tube boiler, viz.:—(*a*) Babcock & Wilcox; (*b*) Niclausse; (*c*) Dürr; and (*d*) Yarrow large-tube, were sufficiently promising to justify their use in His Majesty's Navy in combination with cylindrical boilers. Having concluded their experimental investigations, they are now satisfied that two of these four types, viz., the Babcock and Wilcox, similar to that tried in the *Hermes*, and the Yarrow large-tube, similar to that tried in *Medea*, are satisfactory, and are suitable for use in battleships and cruisers without cylindrical boilers. For the present, the Committee unanimously recommended both types as suitable for Naval requirements.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—Mr. Louis J. Wolf has been appointed assistant electrical engineer by Faversham T.C.

Mr. A. J. C. de Renzi, lately shift engineer at the Heckmondwike Electricity Works, has been appointed shift engineer at Rochdale Corporation Electricity Works.

Electric Tramway Officials.—Stoke-on-Trent T.C. has granted an honorarium of £36 15s. to the borough surveyor and his staff for extra services rendered in connection with the electric tramway to Newcastle-under-Lyme.

Derby T.C. has been recommended by the Tramways Committee to increase the salary of the tramway manager, Mr. F. Harding, from £175 to £200 per annum, with a further increase of £25 on August 3rd, 1905.

The Gloucester T.C. has granted an honorarium of £500 to the surveyor for extra services rendered in connection with the electric tramways, and £200 to be divided between the assistant surveyor and other members of the surveyor's staff.

General.—On the occasion of the Molesey Amateur Regatta, Mr. J. Clifton Robinson, managing director of the London United Tramways, Ltd., received a large company to a garden party at Garricks Villa, Hampton-on-Thames. After luncheon, the company watched the progress of the regatta from the lawn, where the winning post was situated.

Mr. E. J. Jennings, of the St. Pancras undertaking, has been appointed electrical accountant to the Marylebone Borough Council.

The death occurred at Liverpool on July 26th of Mr. W. H. Walmesley, manager at St. Helens for the National Telephone Co., and formerly at Stockport. He died after an operation.

As a memento of the opening of the electric tramways at Gloucester, the chairman of the Tramways Committee (Mr. R. Fream) has been presented by the Corporation with a replica of one of the new cars in silver and polished oak, designed as a smoker's companion. Mrs. Fream received a five o'clock tea service and gold bracelet.

The official circular of the Tramways and Light Railways' Association records the death of its honorary auditor which occurred on July 19th. Mr. J. G. B. Elliott, who has been associated with tramway matters for over 20 years, was secretary of the old Tramways Institute of Great Britain and Ireland.

It is announced that Miss Morse, a niece of the inventor of the Morse telegraph apparatus, has just taken the degree of Doctor of Philosophy *Magna cum laude* at Jena. She is the first lady to receive that degree from the University.

NEW COMPANIES REGISTERED.

Bowen's Electric and Motor Boats, Ltd. (81,645).—This company was registered on July 25th, with a capital of £20,000 in £1 shares (10,000 preference), to acquire the freehold yacht building and electric works on Eel Pie Island, Twickenham, to adopt an agreement with K. Bowen, to construct and establish on Eel Pie Island or elsewhere a dock with patent and other slips, workshops, buildings, machinery, warehouses, and other conveniences, and to carry on the business of builders of, and dealers in, launches, yachts, ships, or boats of all kinds, whether propelled by electricity, steam, or other power, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—K. Bowen, Island Works, Twickenham, engineer; W. E. Mould, 241, Underhill Road, East Dulwich, S.E., clerk; W. J. Walters, 74, Claude Road, Leyton, clerk; W. A. Lawder, 7, Laurence Pountney Hill, E.C., chartered accountant; G. F. Wallace, 7, Laurence Pountney Lane, E.C., mining agent; J. W. Young, 7, Laurence Pountney Hill, E.C., accountant; and N. L. Woodin, 7, Laurence Pountney Hill, E.C., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the first are K. Bowen, C. G. M. Adam, and H. Pritchard; qualification, £500; remuneration as fixed by the company. Registered office, Northumberland Chambers, 23, Northumberland Avenue, W.C.

Rufino and Bahia Blanca Co., Ltd. (81,656).—This company was registered on July 25th, with a capital of £100,000 in £10 shares, to adopt an agreement with G. E. Church and J. Pelleschi, to acquire or construct, equip, maintain, and work railways, tramways, telegraph lines, telephones, and other means of communication, &c., in the Argentine Republic or elsewhere, to acquire running or other powers, rights or easements over any railways, tramways, electric wires, and the like, to acquire, sell, let, cultivate, turn to account and deal in and with land, mines, minerals, and other property, to promote the development of the district, traversed by any carriers of passengers and goods, and transmitters of messages, to construct and maintain wharves, piers, jetties, docks, stores, warehouses, roads, bridges, channels, and other public or private works and conveniences, &c. The first subscribers (each with one share) are:—G. E. Church, Dashwood House, E.C., C.E.; W. D. Coggeshall, 22, Upper Phillimore Gardens, W., C.E.; C. Smith, Harpenden, Herts, C.E.; W. H. Avery, 23, Cambridge Road, Southend, clerk; G. E. Saunders, 51, Larkfield Road, Richmond, clerk; J. H. Chapman, 78, Algernon Road, Lewisham, S.E., clerk; and E. S. Harper, 97, Keslake Road, Kensal Rise, W. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; remuneration, £1,000 per annum, divisible.

Morris Hawkins Electrical Co., Ltd. (81,691).—This company was registered on July 27th, with a capital of £11,000 in £1 shares, to adopt an agreement with the Morris Aiming Tube and Ammunition Co., Ltd., and to carry on the business of electricians, electrical, mechanical, sanitary, gas and water engineers, ironmongers, makers of electric tramcars, motor-cars, carriages, cycles, and vehicles, manufacturers of dynamos, telephones, bells, electroliers, lamps, and other electrical fittings and accessories, &c. The first subscribers (each with one share) are:—Capt. J. W. Reid, 80, Park Avenue, Bedford; S. Waymouth, 19, Kidbrook Park Road, Blackheath, gentleman; S. H. Webster, 89, Portsdown Road, Maida Vale, W., director; W. C. Luff, Malvern Villa, 23, Totteridge Road, Enfield Lock, secretary; A. J. H. Wyatt, 7, Rutland Road, Bedford, engineer; T. Hawkins, Upleadon, Upton Road, Watford, engineer; and A. Redsgaw, 18, Aysgarth Road, Dulwich, S.E., assistant secretary. No initial public issue. The first directors are T. Hawkins and the existing directors of the Morris Aiming Tube and Ammunition Co., Ltd. Registered office, 17, Charing Cross Road, W.C.

Bastian Mercury Vapour Lamp, Ltd. (81,674).—This company was registered on July 27th, with a capital of £20,000 in £1 shares, to acquire the benefit for the United Kingdom and Isle of Man of certain inventions from Bastian & Partners, Ltd., to adopt an agreement with the said company and C. O. Bastian and A. E. Salisbury, and to carry on the business of mercury vapour lamp manufacturers, electricians, &c. The first subscribers (each with one share) are:—C. O. Bastian, 75, Brondesbury Road, N.W., electrical engineer; F. H. Trask, 27, Upper Marylebone Street, clerk; A. E. Salisbury, 64, Pemberton Gardens, N., electrical engineer; H. M. Graham, 147, Leadenhall Street, E.C., chartered accountant; R. Rumney, 39, Victoria Street, S.W., agent; H. E. McKrell, 39, Victoria Street, S.W., electrical engineer; and J. Robertson, 44, Union Road, Clapham, clerk. No initial public issue. Bastian and Partners, Ltd., may nominate two directors; remainder to be appointed by the signatories. Registered office, 39, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Robertson Electric Lamps, Ltd. (39,316).—This company's annual return was filed on May 25th, when 4,500 shares had been taken up out of a nominal capital of £50,000 in 5,000 shares of £10 each. £10 per share has been called up on 4,400 shares, resulting in the receipt of £44,000. £1,000 is considered as paid on 100 shares. Mortgages and charges: £10,000.

Calcutta Tramways Co., Ltd. (14,764).—This company's annual return was filed on June 15th, when 102,268 shares had been taken up out of a nominal capital of £525,000 in 105,000 shares of £5 each. £5 per share has been called up on 44,088 shares, resulting in the receipts of £226,240 (? including payments in advance). £185,100 is considered as paid on 58,180 shares. Mortgages and charges: £350,000.

United River Plate Telephone Co., Ltd. (23,654).—This company's annual return to July 5th has been filed. 68,983 ordinary and 40,000 preference shares have been taken up out of a nominal capital of £1,000,000 in 70,000 ordinary, 40,000 preference, and 90,000 unclassified shares of £5 each. £5 per share has been called up on 42,000 ordinary and 40,000 preference, and £2 10s. per share on 10,983 ordinary, resulting in the receipt of £443,667 10s. (? including payments in advance). £80,000 is considered as paid on 16,000 ordinary shares. Mortgages and charges: £179,947.

Blackheath and Greenwich District Electric Light Co., Ltd. (47,875).—A trust deed dated June 3rd, 1904, to secure debenture stock to an amount not exceeding the paid-up share capital from time to time, and being supplemental to a deed of August 3rd, 1900, securing £120,000 debenture stock, has been registered. The present deed is stamped to cover £30,000 (making a total of £150,000 covered by stamp duty). Property charged by trust deed of 1900; freehold land and hereditaments at Blackwell Point, East Greenwich, leasehold premises at the rear of 23, Westcombe Terrace, London, on the north side of Blackheath Park, Charlton, at Morden Road, Charlton, at Brandrum Road, Lee, and at Burnt Ash Road, Lee, and the company's undertaking and property, present and future, including uncalled capital. The supplementary trust deed contains a covenant by the company to complete the purchase of the undertaking of the Crystal Palace District Electric Supply Co., Ltd., and then to assure to the trustees the freehold and leasehold hereditaments of the said Crystal Palace District Co., and all freehold and leasehold hereditaments which the company may afterwards acquire. Trustees: H. R. Beeton, 18, Austin Friars, E.C.; and W. R. Davies, 10, Moorgate Street, E.C.

Reliance Works Co., Ltd., electric and general engineers, Southampton, (81,358).—£1,000 debentures, created and dated July 8th, 1904, charged on the company's property, present and future, including uncalled capital, have been registered. No trustees.

Robertson Electric Lamps, Ltd. (39,316).—This company's annual return was filed on May 25th, when 4,500 shares had been taken up out of a nominal capital of £50,000 in 5,000 shares of £10 each. £10 per share has been called up on 4,400 shares, resulting in the receipt of £44,000. £1,000 is considered as paid on 100 shares. Mortgages and charges: £10,000.

Eversheds & Vignoles, Ltd. (43,206).—This company's annual return was filed on July 2nd, when 2,700 shares had been taken up out of a nominal capital of £30,000 in £10 shares, and £27,000 had been received. Mortgages and charges: £14,000.

Lisbon Electric Tramways, Ltd. (62,983).—This company's annual return was filed on June 27th, when 500,000 ordinary and 425,553 preference shares had been taken up out of a nominal capital of £1,000,000 in 500,000 ordinary and 500,000 preference shares of £1 each. All the shares are considered as fully paid. Mortgages and charges: £500,000.

A. Hirst & Son, Ltd. (57,889).—This company's annual return was filed on June 20th, when 100 preference and 310 ordinary shares had been taken up out of a nominal capital of £5,000, in 100 preference and 400 ordinary shares of £10 each. £10 per share has been called up on 100 preference and 10 ordinary shares, resulting in the receipt of £1,100. £3,000 is considered as paid on 300 ordinary shares. Mortgages and charges: £2,000.

Barnaby & Co., Ltd., electricians, Rotherham (74,881).—A debenture created 18th, and dated July 19th, 1904, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: Mrs. L. Collins, 16, Damer Street, Sheffield.

Bastian Meter Co., Ltd. (53,304).—Issue on July 18th of £100 debentures, part of series authorised of April 22nd, May 23rd and June 10th, 1901, to secure £6,000, charged on certain land, with premises thereon known as 24, Bartholomew Villas, at Kentish Town, and the company's other assets, present and future, including uncalled capital. Trustees: H. A. Saunders, Chesterfield, and D. J. Cowles, Manor House, Felixstowe. Previously issued of same series: £5,350.

Boardman Electrical Patents, Ltd. (68,712).—This company's annual return (made up to January 14th) was filed on June 21st, when 1,000 shares had been taken up out of a nominal capital of £2,000 in £1 shares. £1,000 is considered as paid. Mortgages and charges: Nil.

Auckland Electric Tramways Co., Ltd. (61,199).—This company's annual return was filed on May 26th, when the entire capital of £900,000 in £10 shares had been taken up. £10 per share has been called up on 28,510 shares, resulting in the receipt of £285,096. £4 remains in arrears. £11,900 is considered as paid on 1,490 shares. Mortgages and charges: £85,100.

Callender's Cable and Construction Co., Ltd. (48,915).—This company's annual return was filed on July 8th, when 35,000 ordinary and 40,000 preference shares had been taken up out of a nominal capital of £500,000 in 60,000 ordinary and 40,000 preference shares of £5 each. £5 per share has been called up on 15,000 ordinary and 40,000 preference shares, resulting in the receipt of £275,000. £100,000 is considered as paid on 20,000 shares. Mortgages and charges: £200,000.

Heswall Electric Light Co., Ltd. (55,482).—This company's annual return was filed on June 14th, when 1,225 shares had been taken up and paid for in full out of a nominal capital of £1,500 in £1 shares Mortgages and charges: nil.

Macartney, McElroy & Co., Ltd. (57,101).—This company's annual return was filed on June 22nd, when 2,912 ordinary shares had been taken up out of a nominal capital of £60,000 in 5,000 ordinary and 1,000 preference shares of £10 each. £10 per share has been called up on 2,892, and £28,920 has been received. £200 is considered as paid on 20 ordinary shares. Mortgages and charges: nil.

Van Raden & Co., Ltd., Electrical Engineers, Coventry (71,388).—A debenture, dated July 18th, 1904, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: Mrs. H. E. Robinson, The Elms, Coventry.

Electrolytic Alkali Co., Ltd., Farnworth-in-Widnes (64,360).—A trust deed dated July 9th, 1904, to secure £50,000 debentures created by resolution of even date, has been registered. Property charged: Freehold land and hereditaments in Middlewich and the company's other assets for the time being, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd.

Perth Electric Tramways, Ltd. (55,935).—Issue on May 18th of £500, and on June 23rd of £34,400 debentures, part of series created December 22nd, 1903, to secure £50,000, charged on the benefit of certain agreements, deposit, provisional order and Acts of Parliament, tramways, tramway undertaking, plant, &c., in Perth, Western Australia. Trustees: Lord A. Butler and J. S. Austen. Previously issued of same series, £100.

British Electric Calibrated Fuse Co., Ltd. (78,488).—Issue on July 23rd of £400 5 per cent. debentures, part of a series created December 4th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £1,750.

ELECTRICITY SUPPLY ACCOUNTS.

Salford Municipal Electricity Supply.

The returns of Manchester's near neighbour for the eighth year's working are exceedingly favourable. The uphill struggle of previous years has resulted in the earning of a substantial surplus (£11,000) this year, and what is of more importance, in placing the departmen in an excellent position to carry on profitable business in future years.

A glance at the figures shows all-round improvement, but more especially in traction and power supply; the latter, indeed, promises to become a special feature, some thousands of H.P. of motor connections being in view. The working costs are an improvement on the very low figure of the previous years, assisted, no doubt, by the improved load factor, which has risen to 26·6 per cent.

The financial result of over £11,000 must be very gratifying to Mr. C. D. Taite, the able head of the department, as also must the allocation of £8,000 of that amount, to depreciation and reserve.

The prices charged are:—Private lighting, 4d.; power, 2d. to 1d. per unit; and public arcs, 1½d. per unit.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	£530,447	£487,708
Number of units sold—		
Private supply { Lighting	1,140,244	908,354
Private supply { Power	911,236	334,507
Public lighting...	179,082	150,328
Traction	5,251,055	3,370,434
Total number of units sold ...	7,481,617	4,763,623
Equivalent No. of 8-C.P. lamps connected	109,582	90,573
H.P. of motors connected	2,002	1,005
Number of public lamps	108 A.	108 A.
Maximum load in KW.	3,200	2,490
Revenue account—		
Gross revenue	£66,813	£45,224
„ expenditure	£23,952	£21,179
„ profit	£42,861	£24,045
Average price obtained per unit—		
Private lighting	2·56d.	3·09d.
Public lighting	1·50d.	1·29d.
Traction	1·95d.	1·95d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£66,813 =	2·14d. per unit.
Works and distribution costs (inc. pub. ltg.)	=	·60d. „
Total working costs	£23,952 =	·77d. „

PROFIT STATEMENT.

Interest on loans	£16,020
Sinking fund	15,066
Balance carried forward	11,775
Gross profit	£42,861

ELECTRIC TRAMWAY ACCOUNTS.

Newcastle-on-Tyne Tramways Depreciation.

The annual report of Mr. Thomas Bowden, professional auditor to the Corporation, has just been issued. In this, considerable space is devoted to the financial position of the tramways. He there points out that, according to the Act, a portion of the revenue is to be applied for the purpose of making an allowance for depreciation. He says:—"It has been contended that the repayment of the borrowed capital over the authorised term is sufficient as a provision for depreciation, &c., and no doubt that much may be said in favour of this argument, if it were definitely assured that the asset constructed out of any particular loan had a 'life' equal to the term authorised for that loan. Experts, however, seem to be more or less unanimous in their opinions that the periods for which the loans have been obtained—viz., permanent way, 30 years; electrical equipment, 20 years; cars, 15 years—are considerably longer than the 'life' of those assets, having regard to ordinary wear and tear, to say nothing of the possibility of ob olescence or antiquation. If this view be accepted—and, according to expert engineers, it is indisputable, it is absurd to suppose that an amount equal to the yearly contribution in repayment of loans is a sufficient sum to set aside as provision for depreciation, exceptional renewals, and as a reserve against those changes entailing a considerable outlay of capital, which the advance of electrical science may render necessary at any time. With the exception of the loan repayments, (which may be regarded as equivalent to a contribution towards depreciation) no further depreciation is provid. d in the accounts submitted to me, nor have I been able to ascertain that any amount has been agreed to by the Committee." He emphasises the fact that the matter is of the utmost importance, and should receive their earnest consideration. He continues:—"The general manager

of the tramways and the city engineer presented a report on depreciation in March, 1903, and expressed an opinion that, in addition to the loans repayment, depreciation should be provided for by the investment and accumulation of £24,700 annually." The result of the application of this principle is that, after charging the advances made out of the city fund during construction, in addition to the interest and redemption during the running period, there is an adverse balance against the tramways undertaking of £19,856 8s. 11d. at March 25th last. He further suggests that if this basis of calculation is accepted, then the above loss appears to be the deficiency for which Sec. 93 of the Tramways Act, 1899, makes provision. He mentions that the sum of £14,768 15s. 5d. has been paid to the city fund. The revenue statement is as follows:—

ACCOUNT SHOWING APPLICATION OF REVENUE AS AT MARCH 25TH, 1904.

Dr.			
To interest on loans from Dec. 16th, 1901, to March 25th, 1904		£57,179	0 1
To contributions in repayment of loans, Dec. 16th, 1901, to March 25th, 1904		46,762	14 5
To advances made out of City fund during construction, and for which no power exists to capitalise:			
Interest and redemption	£20,098 2 5		
Other charges and interest	949 4 11		
		21,047	7 4
To contribution to be invested annually as recommended in the joint report of the general manager of the tramways and City engineer, taking one year only..		24,700	0 0
		£149,689	1 10
Cr.			
By balance of receipts over working and establishment expenses, and cost of maintenance for the period, from Dec. 16th, 1901, to March 25th, 1903	£69,452 10 1		
Less provision for rent of lands, income-tax, &c..	3,089 15 2		
		£66,362	14 11
By balance from March 25th, 1903, to March 25th, 1904		63,469	18 0
		129,832	12 11
By balance being excess of expenditure over income for the 2¼ years ended March 25th, 1904		19,856	8 11
		£149,689	1 10

CITY NOTES.

City and South London Railway Co.

THE ordinary half-yearly meeting of the shareholders of this company was held on Thursday of last week at the offices, 71, Finsbury Pavement, Mr. C. G. Mott in the chair.

The CHAIRMAN, in proposing the adoption of the report, said he was sorry that he had to meet the shareholders with a slightly reduced dividend; but, on the whole, they felt that the result of the half-year had been more favourable than at one time they feared might be the case. Considering that during the past half-year they had had the full competition of the electric trams as against four or five weeks in the corresponding period last year; and considering that during the latter part of the past half-year the weather was exceptionally fine, whereas in the corresponding period it was very unsettled; and further, when they remembered that this half-year they had had to pay the full preference interest in connection with the money raised to pay off the final instalment of the amount they had to pay for the site of St. Mary Woolnoth Church—taking all these things into consideration, he thought the directors were to be congratulated that they were able to recommend payment of a dividend at the rate of 2½ per cent. There had been a decrease in the number of passengers carried—exclusive of season ticket holders—of 284,463, and in the amount received from them of £3,802. On the other hand, the season ticket revenue showed an increase of £1,804, and their rents had increased by £515, so that the net decrease in the receipts was reduced to £1,567. Then they had a decrease in the expenditure of £1,350, and, deducting that from the decreased receipts, the net revenue only showed a reduced balance of £217. After paying the full preference dividends, they were able to recommend the payment of 2½ per cent. dividend on the ordinary shares, which was ¼ per cent. less than last year. As regarded the percentages, the working expenses had been reduced from 46·37 last year to 45·6, which was very satisfactory, when it was remembered that it included not only the railway, but the expenses of the lifts, which were very considerable. The expenses per train mile had been 1·29d. against 1·26d. last year. Locomotive charges were 4·58d. against 4·47d.—very much the same. Traffic expenses had been 6·6d. against 6·3d. The receipts per passenger had decreased from 1·88d. to 1·85d., a very small diminution, but still one which had to be taken into account when millions of passengers were carried. The 1d. fares showed a tendency to increase, and last year they formed, as nearly as possible, one-half the whole traffic. The receipts per train had amounted to 16s. 8d. against 16s. 1d. last year, and per train mile 2s 7d. against 2s. 6d. '48. That was satisfactory, and they had been able to reduce the number of trains this year, and reduce the train mileage from 620,000 to 589,000. The number of passengers per train had increased from 93·8 to 95·9. The total number of passengers carried—exclusive of season ticket holders—was 9,226,987 against 9,511,450, but as they had had a large increase in the number of season ticket holders, he did not believe there had been any material decrease in the number of passengers. They had been trying to cultivate the season tickets, and had issued monthly seasons, 3,309 being taken out last year. It might have been expected that the quarterly season tickets would have shown a decrease, but they had increased from 2,500 to 3,457. As to the Euston extension, the negotiations connected with it had been very laborious and very difficult to carry out, on account of the number of railways and public bodies that they had had to agree with. He was glad to say that very satisfactory arrangements had been made with all the parties, and there was only one little matter still under negotiation which he hoped would shortly be completed, and then they would be in a position to consider the question of acquiring the necessary property and commencing the construction of the line. It had been said by some persons in Parliament that the days of tube railways were over, and that they must look to the electric tram as the future means of locomotion. He did not at all agree with that view; rather he believed that tube railways were now only in their infancy. There was no question that the electric trams were a great institution, and they were a great comfort and convenience to the vast masses of people living in the suburbs, but they were impossible in crowded and congested streets, and it was certain they would never be permitted in the City. As, too, the ordinary road traffic increased—as it was bound to do—there would be a tendency to diminish the speed of electric trams in future years, and what the public wanted was speed. The tube railways had no such difficulties to contend with; but, instead, there was a tendency to increase their speed, and add to the comfort of those who used them. Personally, he felt sure that the tube railways had a great future before them, and those who purchased the ordinary stock of their company at its present absurdly low figure, and locked it up for a time, would one day find that they had made a splendid investment.

Mr. C. S. GRENFELL seconded the motion, and the report was adopted.

Anglo-American Telegraph Co.

MR F. A. BEVAN presided at the half-yearly meeting held last Friday at Winchester House. In moving the adoption of the report (see ELECTRICAL REVIEW, July 29th), he said that the war between Russia and Japan had cast a gloom over commerce generally, and when business was bad the receipts of the company did not flourish. The shareholders would not, therefore, be surprised at the considerable diminution in the traffic receipts for the half-year. They had also earned £4,900 less from the *Minia*. Including this, there was a total decrease of £18,169 in receipts. On the other hand, the expenses of the *Minia* had been less by £3,306, but the general working expenses had been a little more, owing to the normal rise in salaries. There was a decreased amount available for dividend of £16,432. The figures were not cheerful, but they were only sharing the lot of everyone around them. They had had to undertake a thorough overhauling of the cable-ship *Minia*, which had served them well for 36 years, at a cost of about £20,000; £14,000 had been spent during the half-year, and about £6,000 would be paid next half-year, the renewal fund being debited for the purpose. A new ship would have cost £80,000, but they believed that when this expenditure had been made she would be as efficient, or more efficient, than ever, and might continue to serve the company for a great many years to come. If they could have employed the *Minia* during the past half-year, she could have earned a good deal of money by the repair of other company's cables. It had been rather an unfortunate year in the breaking of cables. Unfortunately, some of their own cables also broke, and they had to charter another ship to mend them. The renewal fund had, therefore, also been debited with £7,515 under this head. They hoped when the *Minia* was returned to them in a few weeks, that she would be able to mend their own cables (they hoped that the breaks would be fewer than in the past half-year), and that she would also be able to earn money for herself. In regard to the renewal fund, there was a sort of understanding that when it reached the sum of one million sterling, they should only carry to that fund, so long as it kept up to the million, the interest earned by itself. The fund now amounted to £987,676, but the value of the securities was £33,989 less than their nominal value, leaving it at £953,687. £47,000 of this was held in the shape of cable stock and working expenses, as they had no working capital. Therefore they might say that the securities were worth just over £900,000, and they had about £50,000 in stock and plant. This made £950,000, which was not so very far off the million, and with anything like good luck they should be at that figure at no very distant date. Then it was the intention of the directors to keep it at that figure, and they would then only credit that fund with the interest it earned. The chairman then proceeded to explain, briefly, the main points of the pension scheme, which it was proposed to adopt. The scheme affects about 250 men, and 60 years is mentioned as the retiring age, with option remaining in the exercise of the directors to continue any employé beyond that period if thought desirable. No individual pension will exceed £500 per annum, unless the directors think necessary in the case of special employés, this reservation probably applying to only four officials. The scheme had been estimated to cost £6,800 per annum; £2,000 of this would come from the amount now applied to endowment assurance, which would be discontinued, £4,000 would be derived by reducing the contribution to the renewal fund, and only £800 would be in the yearly accounts of expenditure, so that shareholders would scarcely feel at all what it was proposed to do.

Sir GERALD FITZGERALD seconded the adoption of the report, and, after a brief discussion, it was unanimously carried.

A cordial vote of thanks to the chairman, directors and staff, closed the meeting.

Consolidated Electrical Co.

The *Financial Times* of 3rd inst. says that the report for the period ended March 31st last (to be submitted at the meeting on the 8th inst.), states that the Anglo-Portuguese Telephone Co., Ltd., in which this company is largely interested, continues to make satisfactory progress. The Private Wire and Telephone Installation Co., Ltd., which was formed to take over a branch of this company's business, has, the directors understand, had a satisfactory year's trading. This company holds £2,000 of debentures and a majority of the share capital of the Private Wire Co. The net revenue account of the Consolidated Electrical Co. shows a debit balance of £266. The items of salaries, office expenses, &c., should show further reduction in the next accounts. For many months the efforts of the board were devoted to the reorganisation of the company's finances, and these eventually were placed on a comparatively satisfactory footing. The whole of the debenture debt and other heavy liabilities were paid off, and at the present moment the company is virtually free from floating debt. The directors have also been engaged in overhauling the affairs of the manufacturing branch. Until the close of 1903 business continued fairly good, but latterly there has been a great scarcity of remunerative orders in telephone and electric lighting work, and drastic economies have in consequence been effected in the administration and general management. The office of managing director has been abolished at a saving of £800 per annum. Mr. Leonard Redmayne has succeeded Mr. E. L. Joseph as works manager, and a further saving of £500 per annum has been effected by this change. Wages and other outgoings have been largely reduced, and these economies have been effected without loss of efficiency. Their effect had not been felt at the time of closing the accounts now under review, but will be apparent in the accounts for the current year. The removal from Coventry, so long talked of, is now an accomplished fact. The extensions at Canonbury, in progress at the time the company was reconstructed, are completed, and the factory is now in a thoroughly efficient condition.

Dublin United Tramway Co.

At the half-yearly meeting held in Dublin last week, Mr. W. M. Murphy, who presided, said that they were able to show increased receipts and diminished expenditure. The gross receipts amounted to £128,487, being £3,322 more than the corresponding period of 1903, while the expenditure, £71,172, exhibited a saving of £2,784. £3,000 was sufficient to pay a dividend at the rate of 6 per cent. per annum on the ordinary shares, and they recommended this dividend against 5 per cent. last year. They had a balance of £9,000 at disposal, £2,000 of which they set aside to reserve, the same amount as last year; £3,000 had been allocated towards the cost of electric welding on the Dalkey line, and they carried forward £4,015. At the last meeting he told them that they were experiencing considerable trouble in maintaining the rail joints on the Dalkey line, and that they were trying to remedy the defects by electric welding. This work had since been completed, and it had been entirely successful. The cars now run much more smoothly, and, in his judgement, the life of the rails had been lengthened by at least four or five years beyond the time they would have lasted if they had not carried out this operation. The cost of the whole work was £8,365. They set aside £2,000 towards this out of the profits of the second half-year of 1903, and £3,000 out of the half-year under review, so that there only remained £3,365 to clear off the entire cost of the improvement. Analysing the receipts, he stated that £3,156 of the increase was attributable to passenger traffic, and £197 to parcels, while the expense of handling the parcel traffic was £65 less. It was gratifying to note that, though they had kept the tramways and the electrical and other equipments in a high state of efficiency, the maintenance did not increase; in fact, it was less by £1,708 than it was last year. The generating station again showed remarkable results. Though 94,587 additional units of electricity were generated, the cost was £396 less, the whole cost working out at ·409 of a penny per unit, and establishing a fresh record. The increase in the traffic expenses of £1,163 represented the cost of working 96,719 additional car-miles during the half-year. In the general expenses there was a decrease of £1,575, mostly made up of the item for law and compensation. The company is now engaged in making a short extension of the Palmerston Park line, about 530 yards in length, along the Dartry Road, for which it obtained powers more than five years ago, and it has acquired land at its terminus for building a car-shed, which was very much wanted in that locality.

Central London Railway.

Sir Henry Oakley (chairman) presided on Wednesday at the Holborn Restaurant Hotel over the eighteenth half-yearly ordinary general meeting of the above company, and in moving the adoption of the report, said they had now 2,453 proprietors. Their half-year had been very uneventful; happily they had had no serious trouble, and hardly a mischance, and their business was going on with regularity and with satisfactory results in the way of profit. There was a slight decrease of nearly 1 per cent. in the number of passengers carried. They naturally inquired as to whether this reduction was caused by competition or in any other way. They found that the variation existed over the whole of the line. In some cases there was a slight increase, and in other cases a slight decrease, and so far as they could judge, the cause was the diminution in the spending power of the public. It was so small that one was puzzled to find its source. It was spread over the whole of the line, and the general explanation was that it was due to a flattening of business; they looked forward to its recovery when business generally improved. Putting the result briefly, he might say that they had earned enough to pay 4 per cent. on all the stocks, and, in addition, to have £12,000 unappropriated. With a result like that, it could not be said that they had done badly. The small diminution in the passengers carried had been largely met by modifications in the working, and they had such a liberal service of trains, that the small alteration they had made, although hardly perceptible to the public, made a substantial difference in the working expenses. On capital account they had spent £25,000 mainly in the completion of works which had been undertaken. About £5,800 had been spent in the equipment of the line, and £7,200 on new motor-cars, which almost completed the purchase of 68 cars. They had also spent money on the Bond Street sub-station, and the buildings over the Oxford Street station, which would be used as the offices of the company, and would relieve them of their present heavy charge for office rent. They anticipated no large capital expenditure in the future. The few things they had in hand would probably cost £20,000 to £30,000, and this would leave them with from £200,000 to £300,000 unexpended and practically unreceived capital. Unless the line was extended, they did not contemplate any further expenditure. They had received as revenue from all sources £184,900, and had spent £95,000, leaving £89,000 as profit. With the sum brought forward, they had £108,737 available, of which £50,000 would be expended in paying the dividend, £10,400 set aside for the deferred dividend at the end of the year, and £48,700 would be carried forward to next year, which was £12,600 more than was brought into the half-year. They had about £30,000 to the credit of their contingent account, and £48,000 undivided in the current account, so that they practically stood on clover. It might be asked why they kept so much in hand, and the answer was twofold. First, the Royal Commission on London Locomotion had not yet reported, and the board felt it well to hold in hand money which might be used to deal effectively with any recommendation which might be made as to their line. Secondly, they had two obligations. One was the expenditure on account of the Bill in Parliament, which was suspended, and the second was the loss entailed by the substitution of motor carriages for engines. Together these items would amount to about £90,000. Towards that, if it were necessary to dispose of them to-day, the company had £78,000, and so they would be able to deal with those items without prejudicing the future dividends. He mentioned this, although it was by no means clear that they would be justified in charging the items to revenue. In conclusion, the chairman alluded to the buildings over the stations, which were being pushed on, and which, in the future, would yield them a substantial addition to their income.

Lord Rathmore seconded the motion.

A Shareholder asked if all persons were supplied with workmen's tickets before 7.30 in the morning.

The Chairman: Yes; whether prince or peasant. It is a sort of reward for getting up early.

The Shareholder said he took it that the company made a loss on every workman's ticket issued.

The Chairman said they did not make a loss, but they made no profit.

The report was adopted.

Liverpool Overhead Railway Co.

The report of the directors for the half-year ending June 30th, 1904, to be submitted to the half-yearly meeting on Tuesday next, August 9th, reads as follows:—

The gross revenue receipts amount to £41,927 13s. 3d., and the working expenses to £31,740. The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31, 1902.	Half-year ending June 30, 1903.	Half-year ending Dec. 31, 1903.	Half-year ending June 30, 1904.
First class..	719,287	759,180	766,160	735,223
Second class (including tramways)..	3,384,621	3,334,793	3,670,404	3,402,444
Workmen (special return tickets) ..	1,336,396	1,420,116	1,459,939	1,486,754
Total	5,440,304	5,514,089	5,896,503	5,624,421

The traffic, both on the railway and tramway, has suffered by the decreased work at the docks owing to the small crop of cotton, but, bearing this in mind, the traffic has been fairly well maintained. The traffic working expenses show a satisfactory decrease, but there has been a further outlay on renewal of the permanent way, of which £1,000 has been charged to renewal fund. It is expected that the relaying of the permanent way will be completed this year. The contract for the construction of the northern extension to the Seaforth station of the Lancashire and Yorkshire Railway has been let, and the work is now in progress.

Revenue Account.

Receipts from passenger traffic amount to	£41,137	8	2
Miscellaneous receipts and interest	790	5	1
	£41,927	13	3
Less working expenses	31,739	16	11
	£10,187	16	4
Deduct interest on mortgage debentures, and on calls paid in advance	3,948	19	9
	£6,238	16	7
Add balance brought forward December 31st, 1903 ..	4,132	1	11
Leaving available for dividend	£10,370	18	6

Out of this balance the directors recommend the following dividends:—5 per cent. per annum on preference shares, £3,193 12s. 8d. 1¼ per cent. per annum on ordinary shares, £3,125; leaving balance of £4,052 5s. 10d. to be carried forward.

Official Announcements re Companies.

The following companies have been struck off the Register :—

Amazonas Rubber Estate, Ltd.
Berrenberg Electric Lamp Syndicate, Ltd.
City of Mexico Electric Power Syndicate, Ltd.
Crystal Palace Light Railways and Tramways Co., Ltd.
Electric Tested-Lamp Co., Ltd.
Gas and Electric Lighting Corporation (Mauritius), Ltd.
Joel Electric Carriage-Motor and Battery Syndicate, Ltd.
Love's Electric Traction Co., Ltd.

Waterloo and City Railway Co.—The directors recommend a dividend on the ordinary stock at the rate of 3 per cent. per annum for the half-year ended June 30th, carrying forward a balance of £422. The dividend at June, 1903, was 3¼ per cent. per annum.

Charing Cross and Strand Electricity Supply Corporation.—The directors have declared an interim dividend on the ordinary shares at the rate of 8 per cent. per annum for the half-year ended June 30th, 1904. Warrants will be posted on August 15th.

Great Northern, Piccadilly and Brompton Railway Co.—Sir H. H. Fowler presided at the half-yearly meeting of this company, held at Hamilton House, E.C., on Tuesday. There were no shareholders present. The report was adopted, and the resolution declaring the dividend at the rate of 4 per cent. per annum was approved.

Brompton and Kensington Electricity Supply Co.—The directors have declared an interim dividend on the ordinary shares for the half-year to June 30th at the rate of 9 per cent. per annum.

National Gas Engine Co.—The directors have resolved to pay an interim dividend at the rate of 15 per cent. per annum on the ordinary shares for the six months ended June 30th last.

Blackpool and Fleetwood Tramroad Co.—The report for the half-year ended June 30th last, to be submitted at the meeting on 25th inst., states that, including the sum brought forward from last half-year, the balance of profit, after providing for debenture interest, is £3,530, and the directors recommend a dividend at the rate of 4 per cent. per annum, writing off £500 to depreciation reserve, leaving £30 to be carried forward. The number of passengers carried during the half-year was 779,060. Receipts from all sources amounted to £10,257.

Dublin and Lucan Electric Railway Co.—The report for the half-year ended June 30th last, states that the total receipts show an increase, compared with the corresponding period of 1903, of £296. Expenditure shows a decrease of £173. After providing for debenture interest, there is available £1,211, and it is proposed that a year's dividend be paid on the 5 per cent. preference shares, being 10 per cent. on the half-year, absorbing £950, and reducing the arrears on these shares to a period of nine months. It is also proposed to pay a further sum of £100 off electrical equipment (capital account), and to carry forward £161.

Chelsea Electricity Supply Co.—The directors have declared an interim dividend at the rate of 4½ per cent. per annum on the ordinary shares.

Electro-Peat Coal Co.—It is stated in yesterday's *Financial Times* that this company is calling its statutory meeting for early next week. It is suggested that the public response to the prospectus was practically *nil*, and that the support of the underwriters alone enabled the board to proceed to business.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—Wednesday, August 17th: London United Tramways (1901), Ltd.—Further issue of 25,000 5 per cent. cumulative preference shares of £10 each, fully paid, Nos. 100,001 to 125,000; and has ordered same to be quoted in the Official List.

Waterloo and City Railway Co.—The gross receipts for the past half-year amounted to £17,376, and the working expenses to £8,263. The balance available for dividend is £8,521, and a dividend at the rate of 3 per cent. per annum on the ordinary stock is recommended, leaving £421 to be carried forward. The number of passengers carried was 2,227,350, showing a decrease of 53,783, compared with the corresponding period of 1903.

Crompton & Co.—The report to March 31st states that the net profits amount to £14,584, and, after providing for debenture interest and other items, there remains, with the sum brought forward, a balance of £8,054. The directors propose to place £750 to doubtful debts account, and pay a dividend at the rate of 2½ per cent. for the year, carrying forward £1,221.

STOCKS AND SHARES.

Wednesday Evening.

Nobody expects, as a matter of course, that there will be any volume of business doing throughout the present month. Even if the political horizon were clear, the unexpected stringency in the Money Market would operate as a deterrent to Stock Exchange trade. Already there is talk of a 4 per cent. Bank Rate in connection with the autumn requirements; and while we doubt whether such minimum will come into force for several weeks, the mere apprehension of it is enough to give the investor pause, the idea naturally occurring to him that prices may go lower yet. Electrical descriptions, if not active, continue to command a very fair share of attention, and there are plenty of departments round the Stock Exchange where the dealers would be only too happy to secure as many daily orders as fall to the lot of the Supply and the Electrical Traction sections.

Railway stocks are still quiet, but the Waterloo and City dividend at the rate of 3 per cent. came as something of a disappointment to those who expected a maintenance of last year's 3¼ per cent. rate. The Central London report reads very well, although the prices of the stocks are scarcely altered. Proprietors will notice with appreciation that the prospects of keen competition with the electrified Undergrounds are evidently bearing salutary fruit in the way of making the Central London realise its opportunities for wealth in ways outside the ordinary traffic receipts. All the stations but three, we are told, will shortly be earning revenue from offices, &c., over those stations. The board are now alive to the necessity for utilising all the direct sources of profit, and economies are gradually being introduced. City and South London Ordinary, despite a hopeful speech at the meeting, remains about the same. At the meeting of the Metropolitan Railway last week, Sir Charles Maclaren, M.P., said that if the District Co. were ready he anticipated the new system would be in full working order towards the end of this year. On which point a little scepticism is perhaps allowable.

In referring to the scheme for pneumatic transmission of parcels, newspapers have been making mysterious allusions to a "Syndicate" which is at the back of the affair. We presume they refer to a little company, recently registered, whose *raison d'etre* is the promotion of a Bill for Parliament for the purpose of dealing with the pneumatic parcels idea. The capital is £30,000, and the present suggestion is that 60 per cent. of this shall be called up, *i.e.*, £18,000. Out of this, Parliamentary expenses are thought likely to account for about £10,000, while another £6,000 would be spent upon the experimental plant, leaving a couple of thousand pounds for incidental costs. The "nigger in the hedge" is, of course, the Postmaster-General, and it must be admitted that to a scheme of this kind, he might be rather a terrifying apparition.

Electricity Supply shares have remained very steady, and although the interim dividends are coming up to general anticipation, they have made little difference to the prices. Metropolitan Electric Ordinary are quoted *ex* the return of £6 per share, and will probably advance gradually to something between 17 and 19. At the moment the price is hard at 16 upwards. Brompton and Kensington Ordinary were rather bought on the interim dividend at the rate of 9 per cent. per annum, and the price finishes very firm at 11—11¼ *cum div.* Charing Cross were unchanged in quotation, although fractionally harder on the announcement of the interim dividend of 4s. a share, being at the rate of 8 per cent. per annum. Chelseas were quite unaffected by the interim distribution at the rate of 4½ per cent. for the year, and the price remains steady at 6⅜—6½, with very few changing hands. The 4½ per cent. Debenture continues in strong demand, but the stock is so well held that very little ever finds its way to market. City 5 per cent. and 4½ per cent. Debentures have also been wanted, but here again stock is scarce, and buyers often have considerable difficulty in completing their orders. Countys have been bought in a small way, and show an improvement of ¼, at 7⅞—8¼, whilst the Preference have also been dealt in once or twice on the basis of 11—11½. Westminsters have shown a fair amount of activity, and close steady at 12¼—12¾ *ex div.* The interim dividend at the rate of 13 per cent. is about what was expected, and had no effect on the price. Urban Ordinary and Preference have received a little more attention during the last week or so, and an advance in the prices is shown in both cases. As regards the Debenture, a large block of stock, which has been on the market for some while past, has practically been absorbed, and the price is now 1—2 prem.

In the traction division, Anglo-Argentine Trams Ordinary and Preference have been an active market, and are both ⅛ higher at 6—6¼ and 5⅛—5⅜ respectively. A fair amount has been put through in British Electric Traction issues, but prices show no quotable change on the week. Metropolitan Tramway Deferred were wanted on a large scale, and the last price is hard at 5s.—6s. The Debenture has changed hands pretty freely on the basis of 97—99.

The telegraph division keeps steady on the whole, with only a small business doing. Easterns are a shade lower on a few shares coming into the market.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations July 27th.	Closing Quotations Aug. 3rd.	Business done week ended Aug. 3rd, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	46 — 49	45 — 48 xd	45	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	90 — 92 xd	91	90⅜
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6⅛— 7	6⅛— 7	6⅛	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5⅛	4⅞— 5⅛xd	..	..
13,388,300§	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 95	94 — 96	95½	..
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	15⅞	..
12,931	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710‡	Direct United States Cable	20	3½%	3½%	3 %	10 — 10½	10 — 10½xd	10¼	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	127 —132	124 —129 xd	126½	125½
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	87 — 90	86 — 89	87½	87
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106½	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11⅜— 12½	11⅜— 12½	..	..
820,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	103 —106 xd	104½	103½
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	97 —100	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5%	£3 16 7*	5%	8⅞— 9⅛	8⅞— 9⅛	8⅞	..
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅛— 13⅜	13⅛— 13⅜	13 7/16	13 7/16
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	25⅛— 26½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	43½	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	106 —108	103 —105 xd	104½	103
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	88 — 91	86 — 89 xd	87½	85½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14 xd	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13 xd	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5 — 5⅛xd	5 1/16	5⅛
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98½	98½
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104	103½
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	64 — 66	64 — 66	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	⅛— 1 1/16	⅛— 1 1/16	1	..
50,000	Do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,899	Reuter's	8	5 %	5 %	..	6½— 7⅛	6½— 7⅛	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5 1/16	..
179,947‡	Do. do. 6 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,600	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	97 —100	95 — 98	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 267,930	10	7 %	7 %	7 %	1⅞— 12⅜	1⅞— 1 ⅜	12 7/16	..
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6¼— 6¾	6¼— 6¾	6½	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8⅛— 9	8⅛— 9	9	..
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅞— 11⅛	10⅞— 11⅛	..	..
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	116 —119	118½	117½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅞— 6⅛	5⅞— 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞— 6⅛	6⅛— 6 xd	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	101 —104	101 —104	..	..
50,000	Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅛— ¼	⅛— ¼	..	..
50,000	Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	¼— 1	¼— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	¾— 1⅛	¾— 1⅛	1 1/16	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	71 — 76	71 — 76	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9¼— 10⅛	9⅛— 10⅛	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	102½	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	89 — 91	89 — 91	..	..
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —104	102 —104	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	79 — 81	..	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2½%	47 — 49	46 — 48	47⅞	47
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅛— 2	1⅛— 2	1⅛	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	94 — 97	94 — 97	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	½— ⅝	½— ⅝	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	80	79
100,000‡	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	78 — 82	79 — 83	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½xd	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2¼— 2⅝	2 — 2⅝xd	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9⅛	9 — 9⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	96½	95½
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11 — 12	11 — 12	11	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	18⅛	..
600,000‡	Do. do. do. 4 % 1st Mort. Deb	100	..	..	..	100 —103	100 —103	..	..
87,500	‡Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅞— 4	3⅞— 4	..	..
10,000	‡ Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	36 — 39	37½	36
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	99 —102	99 —102	..	..
440,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	89 — 92	89 — 92	90	..

period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations July 27th.	Closing Quotations Aug. 3rd.	Business done week ended Aug. 3rd, 1904. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	† 1	..	..	..	⅝ — ¾	⅝ — ¾	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..
100,000	Do. 4½% 1st Deb. Stock	100	..	..	..	100 —105	102 —106	105	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10⅜ — 11½	10⅜ — 11½	11⅞	11⅛
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½ — 10⅝	10½ — 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7⅞ — 8	7⅞ — 8	7⅞	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½ — 5	4½ — 5	..	..
40 000	Do. do. 1903	5	..	..	..	4½ — 5	4½ — 5	4⅛	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103½	..
44,436	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6½ — 6⅝	6½ — 6⅝	..	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10⅜ — 11½	10⅜ — 11½	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13⅛	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	120 —125	120 —125	124	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	7⅞ — 8½	7⅞ — 8½	8⅛	8
20,000	Do. do. do. 6 % Pref. 40,001—60,000.	10	..	..	..	11 — 12	11 — 12	11⅜	..
400,000	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	100 —103	102	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6 — 6½	5½ — 6⅛ xd	6⅜	6
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅝ — 6	5½ — 6	5⅞	5⅝
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	104 —107	104 —107 xd	106½	105½
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	8	..	..	..	1½ — 1⅝	1½ — 1⅝	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4⅝ — 5⅛	5 — 5⅛	..	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	94 — 97	94 — 97	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6½%	7½%	8½%	21½ — 22½	15½ — 16½ xb	16⅝	16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	13½ — 14½	13½ — 14½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14⅝ — 15⅝	14 — 15 xd	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9 xd	..	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2¾ — 3½	2¾ — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	88 — 88 xd	..	..
65,000	South London Electricity Supply, Ord.	5	..	1½%	3 %	3⅜ — 4½	4 — 4½	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅛ — 5	4⅛ — 5	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅛ — 5	4⅛ — 5	4⅞	4⅜
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12½ — 13½	12 — 13 xd	12¹³⁄₁₆	12⅝
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	..	..

* Subject to Founders Shares. † Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, August 3rd.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	32/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Murinate (crystal) ..	per ton	£33 10	..
a	" "	per ton	£20	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	" (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£21 10	..
a	Lead, Nitrate	per ton	£24	..
a	" White Sugar	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90%, a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	" Caustic (75/80%).. ..	per ton	£24	..
a	" Bisulphate	per ton	£35	..
a	Shellac	per cwt.	260/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	" Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	" Crystals	per ton	£3	..
a	" Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	" Wire, in ton lots ..	per ton	£168	..
b	" Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £130	..
c	Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	..
c	" Tube (brazed)	per lb.	6¾d.	..
c	" " (solid drawn).. ..	per lb.	7¼d.	..
c	" Wire, basis..	per lb.	6¼d.	..
c	Copper Tubes (brazed)	per lb.	9¼d.	..
c	" " (solid drawn) ..	per lb.	8¾d.	..
k	Copper Bars (best selected	per ton	£70	..

	METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g	Copper Sheet	per ton	£70	..
g	" Rod	per ton	£70	..
e	" (Electrolytic) Bars ..	per ton	£62	..
e	" " Sheets ..	per ton	£78	..
e	" " Rod ..	per ton	£72	..
e	" " H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	3/8	..
f	" Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/10½ to 5/-	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	42/10½	..
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12	inc.
g	" Sheet	per ton	£11 17s. 6d.	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 17 6	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	" " " medium	per lb.	2/6 to 4/-	..
d	" " " large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	" rolled bars & rods	per lb.	1/- to 1/3	..
p	" " strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
c	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	" " in bars		£15 to £40	..
g	Tin, Block	per ton	£124 to £125	..
g	" Foil	per lb.	1/6	..
n	" Wire, Nos. 1 to 16	per lb.	1/6½	..
p	White Anti-friction Metals—			..
	"White Ant's" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	" 6 les. Flax	per lb.	5½d.	..
j	" 8 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	" 10 lbs. Russian, single ..	per lb.	4½d.	..
j	" 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh'ts (Vieille Montagne bnd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

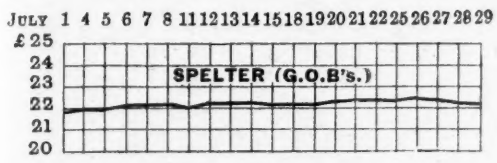
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Tramways.	Aberdeen	July 30	1,654	+403	9	13,106	+ 2,889	10	—
	Bath	" 27	688	—	31	17,949	—	12½	—
	Birmingham	" 30	5,489	+144	32	166,781	+10,670	32	—
	Blackburn	" 29	999	+144	18	17,533	+ 1,555	13½	—
	Blackpool	" 24	1,958	+424	17	17,878	+ 1,345	8½	—
	" —Fleetw'd	" 30	1,292	+1·5	5	4,863	— 150	7½	—
	" —Lytham	" 28	806	+148	39	11,555	+ 6,025	7½	—
	Bolton	" 31	1,929	+138	18	33,852	+ 159	25	—
	Bournemouth ..	" 27	1,163	+154	17	18,858	—	10½	—
	Bradford	" 23	4,880	+760	16	76,666	+13,208	50	—
	Brighton	" 31	1,372	+289	—	17,569	—	7½	—
	Bristol	" 29	5,309	+195	—	—	—	28	—
	Devonport ..	" 22	620	+ 35	29	15,129	+ 2,486	5	—
	Dudley—Sto'rb'ge	" 22	994	+105	29	24,299	+ 918	18⅝	—
	Gateshead ..	" 22	958	+ 43	29	26,012	+ 1,254	10½	+ ⅜
	Gr'n'k—Pt. Glasgw	" 22	848	— 23	29	16,122	+ 775	7½	—
	Oldham—Ashton	" 22	620	+ 18	29	15,733	— 773	8	—
	Potteries	" 22	1,902	+368	29	49,818	+ 4,358	25½	—
	South Staffs. ..	" 22	735	—302	29	22,340	— 2,315	21½	—
	Swansea	" 22	942	+370	29	15,412	+ 959	5½	—
	Wolverhampton..	" 22	418	+ 4	29	11,058	— 192	10⅜	+8
	Yorks. Wool Dist.	" 22	755	+368	29	17,087	+ 7,397	6	—
	Miscellaneous ..	" 22	4,956	—	29	88,719	—	—	—
	Burnley	" 30	986	+156	—	—	—	10½	+3½
	Burton-on-Trent ..	" 24	393	—	16½	5,818	—	8½	—
	Cardiff	" 23	2,162	+ 26	16	34,006	+ 813	14	—
	Chatham & District	" 28	648	+ 80	30	17,324	+ 2,182	8·56	—
	Cork	" 28	566	—171	30	13,727	— 1,315	9	—
	Dover	" 23	275	+ 8	29	5,934	— 810	3½	—
Brit. Elec. Tramways.	Dublin	July 29	5,429	—146	—	22,766	— 4,413	47	+ ½
	East Ham	" 30	748	+ 91	17	13,396	+ 1,289	5	+ ½
	Glasgow	" 30	12,975	+ 566	9	123,531	+ 8,122	71½	+6½
	Halifax (2 weeks) ..	" 27	3,343	+277	17	26,350	+ 1,871	33	+1½
	Huddersfield ..	" 30	1,312	+ 65	17	—	—	28	—
	Hull	" 30	2,270	+442	17	37,309	+ 4,672	13	+2½
	Ilkeston	" 27	148	— 42	17	2,275	—	3·5	—
	Ipswich	" 23	580	—	16	8,273	—	10½	—
	Isle of Thanet ..	" 30	1,526	+308	30	16,599	+ 87	10½	—
	Leeds	" 23	5,971	+ 13	—	100,140	+ 5,908	81½	+2
	Liverpool	" 23	14,144	+ 3328	30	307,393	+10,827	103	—
	London C. C. ..	" 23	14,521	+4055	16	200,279	+37,171	46⅞	+6½
	Manchester	" 30	12,818	+591	17	212,491	+ 7,452	131½	—
	Newcastle	" 30	3,770	+281	—	—	—	17	—
	Portsmouth	" 30	2,229	+247	—	35,858	+ 3,298	14½	—
	Salford	" 25	4,827	+271	—	69,003	+ 5,530	53	—
	Sheffield	" 24	4,861	+ 98	17	81,247	+ 2,104	33	+6½
	Southampton ..	" 28	1,031	— 77	—	—	—	9	—
	Southend-on-Sea ..	" 27	510	+109	17	6,176	+ 690	6½	—
	Sunderland	" 24	1,564	+138	16	21,521	+ 890	20	+1
	Tyneside	" 27	421	+ 58	30	11,263	+ 2,049	8·9	+·4
	West Ham	" 21	1,127	—	21	16,646	—	8	—
	Wolverhampton ..	" 27	726	+ 258	—	—	—	9·5	—
	Cen. London Rly. ..	" 30	5,895	—280	4	24,628	— 1,421	6	—
	City & S. Lon. Rly.	" 31	1,884	—171	5	11,819	— 699	5½	—
	Dublin—Lucan Rly.	" 29	146	— 49	4	462	+ 64	7	—
	G. N. and City Ry.	" 30	985	—	24	22,338	—	3½	—
	L'pool Overh'd Rly.	" 1	1,542	— 86	5	8,619	+ 49	6½	+4½
	Mersey Railway ..	" 23	1,594	+280	3	4,407	+ 341	4½	—

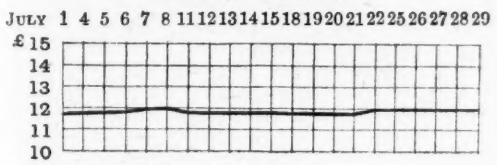
* Compared with the corresponding period of 1903.

METAL MARKET.

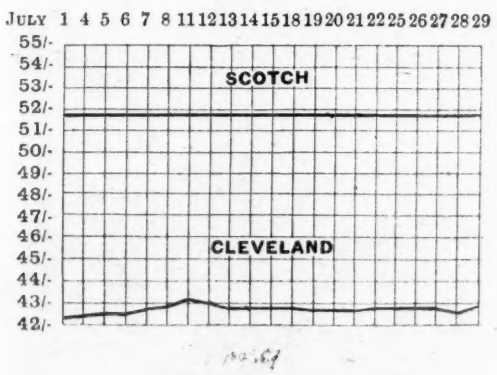
Fluctuations in July.



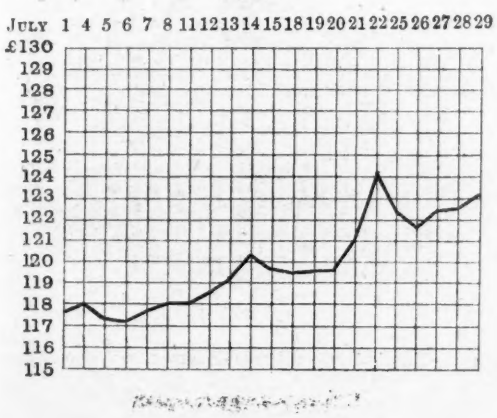
LEAD (ENGLISH).



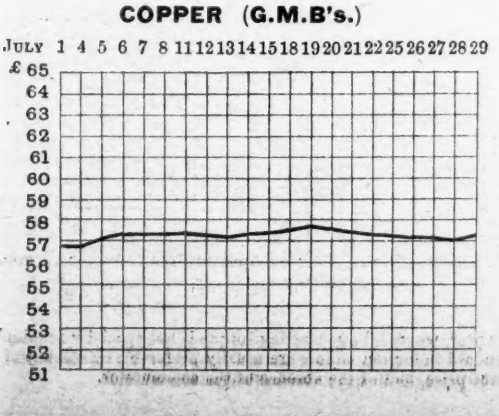
IRON.



TIN.



COPPER (G.M.B's.)



THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

THERE is little new to record in regard to the trade in Germany, although prices are said to have slightly improved during the past three months. About 1,500 workmen are engaged on the construction of steam turbines for the A.E.G., and the Lahmeyer Co. has once more come forward with a proposal to pay a dividend, while the Schuckert Co. has compromised the dispute with five former directors by agreeing to pay them the sum of £10,000.

GERMAN COMPANIES.

The Continental Company for Electrical Enterprises, of Nuremberg, has incurred a fresh loss on its share capital of £1,600,000, of which approximately £1,440,000 is held by the Schuckert Co. Either as sole or part owner, the company is interested in many electric tramway and lighting undertakings, and is well known as the promoter of the Lange suspended electric railway system, which was first introduced between Barmen and Elberfeld. The report of the directors for 1903-4 shows receipts from interest on investments and profits from various enterprises of a total of £121,881, as compared with £112,786 in the previous year. On the other hand, administrative expenses absorb £15,563, interest on bonds £19,800, bank interest charges and commissions £67,173, renewals and capital redemption of undertakings managed by the company £19,127, and depreciation and losses on securities £34,568. These figures represent a loss of £34,350 for the year, as against a loss of £21,007 in the preceding twelve months. The final result is an increase in the deficit of £58,966 in 1902-3 to £93,316. The directors state that an improvement took place in the majority of the undertakings during the year. The losses are attributed to the suspension of Bourse quotations for certain investments, and the depreciation of various shares.

The accounts of the Lahmeyer Electricity Co., of Frankfort-on-Main, show gross profits amounting to £186,114 for the financial year 1903-4, as compared with £115,211 in the preceding period. After meeting general expenses, deducting £29,848 for interest on bonds, as against £12,368, £22,769 for bank interest charges and commissions, and making provision for depreciation, there remains a net sum of £30,831 available for disposal. It is proposed to pay a dividend at the rate of 2½ per cent. on the share capital of £1,000,000, whereas the previous year's trading resulted in a loss of £18,584, which was covered by the profits realised by the company on absorbing the German Company for Electrical Enterprises. The works were insufficiently employed at the beginning of the financial year, and the normal position of affairs was only reached in October. As a consequence, no profits were earned in the first half of the year, the whole return arising from the transactions which were completed in the second half, although prices continued unsatisfactory. The electric lighting stations and tramways belonging to the company, together with those in which it is largely interested, developed in a satisfactory manner during the year.

The general meeting of the Felten & Guilleaume Carlswerk Co., of Mulheim-on-Rhine, when shareholders were present representing the entire capital of £1,800,000, approved the accounts for the year 1903, and the payment of a dividend at the rate of 5 per cent., being the same as in the preceding year. According to the accounts, the gross profits realised on manufacturing operations reached £249,427 as compared with £255,193 in 1903, while sums of £24,532 and £4,411 were received as return on investments and from the payment of a claim respectively. After meeting working expenses and other charges, and writing down the value of the buildings by 2½ per cent., and the machinery and plant by 10 per cent., the net profits amount to £113,840 as against £99,031 in 1902.

The directors of the Voigt & Haeffner Co., of Frankfort-on-Main, in their report for 1903, point out that the year yielded more favourable results than its immediate predecessor. The gross profits total £23,193, as compared with £16,120, and the net profits amount to £5,186. After writing off the slight deficit brought forward from the previous year, the net profits are shown to be £4,360, which allows of the payment of a dividend at the rate of 3 per cent. for the year. The report states that competition continues to be extraordinarily severe, and profits do not bear any proportion to the demands made upon the makers for reliable manufactures, or for intellectual application in the solution of new problems. The company, whose prospects for the present year are described as favourable, employs officials and workpeople to the number of 620. The following table shows the results of several other companies;—

	Dividends in per cent. 1903	1902
German Transmarine Electricity Co., Berlin...	6	3
Electra Co., Dresden	1½	1
Berggeist Electricity Works Co., Bruhl ...	1	0
Saxon Electricity (Poschmaun) Co., Dresden...	0	0
Welter Electricity Co., Cologne	0	0
Krawinklerbrucke Works	0	0
Electricity (Buchner) Co., Wiesbaden... ...	0	0
Electrotechnical Enterprises Co., Munich ...	0	0
Electricity Works (Poge) Co., Chemnitz ...	0	0

FRENCH AND OTHER COMPANIES.

The Compagnie Continentale Edison, which has an ordinary share capital of £400,000, has declared a dividend at the rate of 32s. per share for 1903, while 8s. per share has been paid on the founder shares. The net profits after writing off £80,000 for depre-

ciation, as against £66,000 in 1902, amounted to £41,762, as compared with £41,896 in the preceding year.

The Société d'Electro-Métallurgie de Dives has succeeded in making a little progress, although the results for 1903 are apparently due to the higher prices which prevailed for copper and to the booking of stocks in a corresponding way. At the end of 1902 the deficit reached a total of £18,731, but as the net profits for 1903 amount to £20,904, it has been possible to extinguish the debit balance brought forward and to carry £2,173 to the next account. The company, whose united share and bond capital is £750,000, experienced a loss of over £9,000, owing to damages caused by fire during the year.

The Société Parisienne pour l'Industrie des Chemins de Fer et des Tramways Electriques, which has a share capital of £2,000,000, of which £1,250,000 is paid up, is interested in several electric tramways and lighting works. Among the latter may be mentioned the Société d'Electricité de Paris, which is erecting at St. Denis the largest central station in the area of the French capital, where four turbines of a combined output of 20,000 kw. are to be installed as a beginning, the greater part of the production having already been ordered. The net profits earned by the Société Parisienne in 1903, amounted to £53,218, as compared with £50,384 in the previous year. It is proposed to pay a dividend at the rate of 4 per cent., whereas a year ago the entire surplus was devoted to the purpose of writing down the value of the securities in the company's portfolio.

The electrical machinery industry in Italy has now been consolidated for the purpose of more effectively meeting foreign competition. With the exception of the firm of Ansaldo-Armstrong, of Genoa, who are said only to make generators for their own requirements, the production of this class of machinery is now vested in three firms. These are the Milan firms of Gadda & Co., and Brioschi, Finzi & Co., and the Sociéta Elettrica Italiana, of Turin. The two former entered into a working agreement a year or two ago, and the latter has now been added. The agreement provided for the appointment of a committee selected from the directors of the three companies for the purpose of accepting orders and distributing them among the three works, and, in fact, for undertaking the technical and commercial management of them. It is proposed to divide the net profits by the allocation of 45 per cent. to Gadda and Co., 22 per cent. to Brioschi, Finzi & Co., and 33 per cent. to the Sociéta Elettrica Italiana. The total capital of the three companies is £280,000. The only other firm which comes into consideration as a supplier of machinery, is the Italian branch of the Brown-Boveri Co., but this has hitherto only made instruments of precision and sends all orders for machinery to the head-quarters in Switzerland.

The last report issued by the Russian Siemens & Halske Co. covers a period of 18 months ended with December 31st, 1903. It shows net profits amounting to £3,478 as compared with a considerable loss in 1901-2. The sum available for disposal has been devoted to a reduction of the existing deficit, which is now represented by £16,341. As a result of the combination of the German Schuckert and Siemens interests, an understanding has been arrived at in St. Petersburg in the sense that the principal of the Schuckert Co. has become a member of the board of the Siemens & Halske Co.

SINGLE-PHASE MOTORS: V. A. FYNN'S PATENT.

The following notes give a brief description of the latest type of repulsion-induction motors which has been placed on the market. These motors are supplied by Messrs. Witting, Eborall & Co., who have sent us the following particulars.

The motors are manufactured under Mr. V. A. Fynn's patents; they are of the commutator type, specially designed to give a large starting torque with a comparatively small current consumption, and are specially suitable for lift and crane work. In these motors the rotor has two inter-connected windings, the ends of the one being connected to slip-rings, and the ends of the coils of the other to a commutator. The winding of the two-pole machine is given in diagram in fig. 1, and fig. 2 shows a four-pole motor.

The stator has simply a standard three-phase winding.

In the larger sizes of motors the brushes on the commutator are connected through a variable resistance, which is gradually cut out as the motor starts, and is short-circuited in the running position. In the smaller motors the brushes are permanently short-circuited. The brushes are fixed once for all, and no adjustment for these is necessary. The slip-ring brushes are connected to a resistance exactly similar to the starter of an ordinary three-phase motor.

The construction of the motor is such that at starting it operates as a repulsion motor, and at full speed as a synchronous motor; at intermediate speeds the motor works partly as an induction, and partly as a repulsion motor. Sparkless running of the brushes is guaranteed at any speed.

A set of curves is here given to show the performance of a 220-volt 50-cycle 4-B H.P. motor (fig. 3).

With regard to the starting performance generally, the makers guarantee that when starting with a torque equal to that at full-load, the starting current will not exceed $\frac{3}{4}$ of the full-load current; or when starting with a torque equal to twice that at full-load, the starting current will not exceed $1\frac{1}{2}$ times the full-load current, it being assumed that the pressure at the terminals of the stator remains constant. Those who have had experience with single-phase motors will realise the excellence of this starting performance.

As stated above, the motors are specially suitable for lifts and hoists, but they can be equally well used in other classes of work;

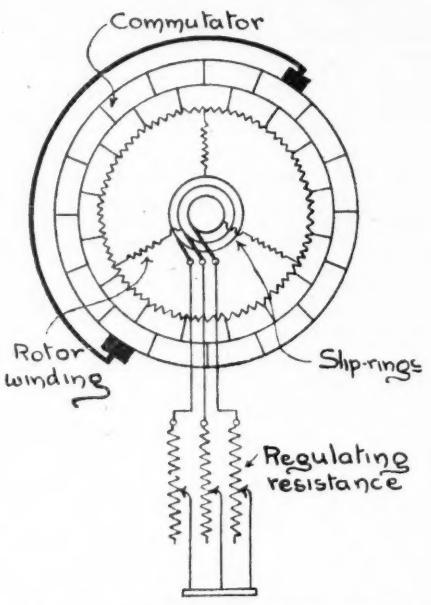


Fig. 1.—Diagram of Winding of Fynn's Single-Phase Motor.

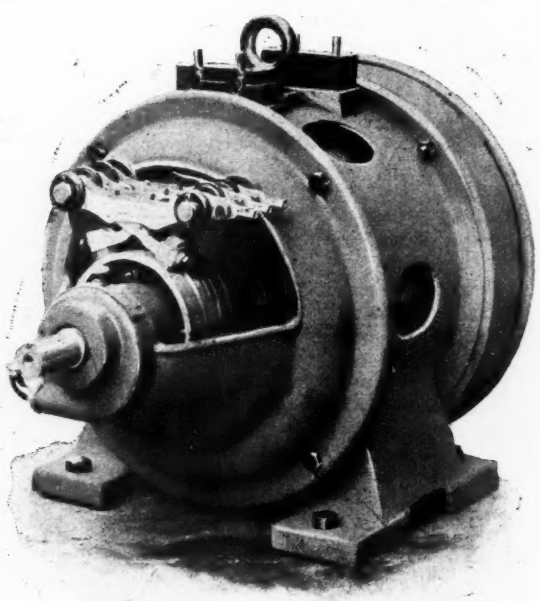


Fig. 2.—Fynn's Patent Single-Phase Commutator Motor.

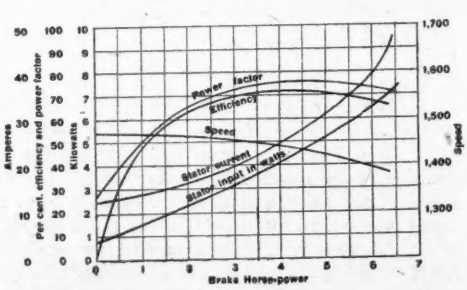


Fig. 3.—Brake Test of 5-B.H.P. Single-Phase Motor. 220 volts, 50 cycles, 1,500 r.p.m.

however, where a large starting torque is not specially required, the standard induction motors are usually preferable on account of their lower price, and of the absence of the commutator.

THE LOCATION OF LIGHTNING ARRESTERS.

By J. W., A.M.I.E.E.

It is more particularly of the lightning arresters on traction feeders at the station end that we mean to treat. By the imitative propensity of the race (a failing from which engineers are not entirely free), practice in this connection has become absolutely stereotyped. It is one of those methods that have come to us unquestioned from the United States, and the why and wherefore has apparently never been sought; otherwise it is fairly certain there could not exist such unanimity in the mode. For it happens that in this case there is very slender foundation indeed for the almost universal trust based upon the practice. It is a practice, moreover, that involves needless complication and expense, and a useful purpose may, therefore, be served by a brief discussion of the *pros* and *cons* of the question, and by giving some indication as to how it may be improved.

The usual location of the lightning arresters in a traction generating station is on the switchboard, on the back of the feeder panels. It is not a convenient or ideal place for apparatus of this nature, and why it was put there in the first place would, perhaps, be hard to trace; but probably it was done with the idea of keeping the various apparatus together. A universal adjunct of the arrester in this position is the kicking coil, which is credited with very considerable powers of holding back the lightning discharge and forcing it to break across the air-gap of the arrester. It is chiefly on the value of this kicking coil that the prevailing confidence is at fault. Once this is whittled down to its just proportions, it becomes very evident that there are much better locations in the station for the lightning arresters than the back of the feeder panels.

It is not intended to go deeply into the mathematics of the question; it would be superfluous, as all we need is a rough practical estimate of the comparative value of the kicking coil. The coil is commonly made up in two forms, the one a cylindrical spiral or helix, the other a discoidal spiral. The former is employed chiefly on direct current work, and the latter, which is the more efficient shape, is used for alternating current circuits. The helix is usually made of round copper rod of suitable section wound hot upon as small a mandrel as practicable. It consists of from 12 to 20 turns, according to the total length it is convenient to allow.

The following are the proportions of some average standard kicking coils:—

Size.	No. of turns.	Mean diameter.	Pitch of spiral.	Diameter of rod.	Length of conductor.
200 amps.	16	2½ in.	⅛ in.	½ in.	126 in.
400 amps.	16	2⅞ in.	⅞ in.	⅝ in.	138 in.
600 amps.	16	3 in.	1 in.	⅞ in.	150 in.

The "kicking" properties of the coil depend, of course, upon the self-induction thereof. Now, the coefficient of self-induction of a ring coil, made up of a number of turns of cotton-covered wire wound close, and aggregating to a coil section which is small compared with the area enclosed by the ring, will be approximately:—

$$L = 6\ S^2 \times \lambda,$$

where S is number of turns, and λ the mean length per turn in cms. This is the maximum inductance obtainable for a coil of a given number of turns and with a given length of conductor, in the absence of an iron core. Our kicking coil cannot possibly attain to it, as the turns must be spaced apart, and the conductor section is so much larger than assumed in the formula. The inductance, or coefficient of self-induction, of turns arranged in a discoidal spiral a small distance apart, is as a very rough approximation, something less than $L = 6.8^{\frac{5}{3}} \times \lambda$, and a little greater than $L = 6\ S^{\frac{3}{2}} \times \lambda$.

These two formulæ are quite arbitrary, and are simply taken as convenient boundaries between which lie the actual values; and, by the way, they are the boundary of our mathematics on this journey.

The inductance of the helix will be smaller yet, and if we allow it the lower value, we shall be doing it more than justice. Since S λ represents the total length of the conductor in the coil, which we will call l, it follows that the maximum possible inductance of a conductor of length l, when wound into a coreless coil, will be:—

$L = 6\ S\ l$ when the coil is a large close-wound ring,

$L = 6\ S^{\frac{3}{2}}\ l$ when the coil is an open discoidal spiral, and

$L = 6\ S^{\frac{1}{2}}\ l$ when the coil is an open helix.

In the case of coils of 16 turns, such as we are discussing, the value of coiling the conductor can now be estimated. Thus, in the first and best possible case, coiling will raise the inductance to 16 times what it is with the conductor straight. For the second case, it adds to the inductance by six times. For the third case, the gain is only four times; and, as we have seen, this is the best result that can be expected from the helical type.

It follows that if we can connect the arrester to the feeder some 40 or 50 ft. away from the switchboard, the intervening length of conductor will have all, or more than, the effect of a kicking coil; and if the available distance within the station be short, a better and more efficient form of coil can be made of a few turns of the cable bound together in a ring. When the feeder enters from overhead, obviously the proper position for the arrester is as near the point of entry as possible. On underground feeders there are reasonable objections against cutting into the cable to make another connection, but only a narrow ring of insulation need be stripped to get a sufficient joint. On lead-covered, or metal sheathed cables, there is little need of a lightning arrester at all at the station end; one should be located at the far end to protect the cable, and if one is added in the station to serve as a discharge gap for possible surges of potential in the cable, there is clearly no call for a kicking coil also, as it would be impotent against the sort of discharge that could come through a long length of main.

The arrester should evidently be placed quite close to the feeder it serves to discharge, and also quite close to a good ground, and the connections to it must be short and of ample section; otherwise they will offer appreciable impedance, which will detract from the directive influence exerted by the impedance in the main circuit. These conditions are more easily met when the arrester is arranged as a separate item independent of the switchboard. The one thing to be observed is to make as effective use as possible of the inherent impedance of the connections. If this is done, there is usually little utility in adding artificial impedance of the ineffectual sort described above.

There is no doubt of the advisability of having a suitable discharge gap on any circuit that is likely to be subjected to abnormal static charges or effects, and if the switchboard is the most convenient and effective position for it, it should be placed there. But there is no reason in making a universal practice of locating it there, or of complicating the arrangements with an elaborate and costly "kicking coil," which, as we have seen, cannot add in any great proportion to the impedance already existing in the line of connections from the feeder to the switchboard, and from the switchboard to the generator.

An Electro-Photographic Process.—Dr. S. Kalischer and E. Ruhmer, of Berlin, have taken out a German patent for a process of obtaining photographic pictures on metallic plates covered with selenium which depends partly upon electrolytic action. The metallic plate is coated with selenium in such a way that a film of varnish insulates the thin layer of selenium from the metallic surface. The plate is brought into a glass vessel and made the cathode of a weak current of electricity, whilst a lens throws upon it an image of the object that has to be reproduced. This causes the different portions of the selenium film which correspond with different portions of the picture to exhibit different degrees of conductivity. If an ordinary silver bath (*e.g.*, a solution of potassium silver cyanide) is used as the electrolyte, and a plate of pure silver as the anode, metallic silver white in colour is deposited on those parts of the plate which represent the "lights" of the original, and a positive is obtained that reproduces all the gradations of the object photographed. When the picture has fully developed in the bath, it is taken out and well dried. No process of fixing is requisite.

GLASGOW MUNICIPAL TELEPHONE SYSTEM: ESTIMATES AND RESULTS COMPARED.

By HERBERT LAWS WEBB.

I RESPOND with pleasure to the request of the Editors of the ELECTRICAL REVIEW for an article on this question. At the Glasgow Telephone Inquiry in 1897, I pointed out in the course of my evidence what appeared to me to be the fundamental defects of the estimate presented at that inquiry for a Glasgow municipal exchange. The main bearing of my evidence was that the plant provided for in the estimate would not yield the number of working subscribers' lines which the revenue estimate counted upon, and that the cost in plant of serving such a large area at low rates had not been adequately recognised. To put it briefly, the estimate was fundamentally wrong in the small amount of plant which it allowed in proportion to the number of subscribers to be served. The actual results have fully justified this contention.

In order to make clear the wide difference between the results of actual practice and the estimate on which the system was based, I have prepared three curves which illustrate very clearly the great contrast between the amount of plant in proportion to subscribers which was estimated to be required and the amount which has actually been constructed. A simple comparison of the actual capital spent and the actual gross revenue earned with the estimated capital expenditure and the estimated gross revenue, shows very clearly a great disparity between the estimates and the results. The curves throw light on the cause of this disparity.

The original estimate purported to show that the total cost of a system to serve 5,200 subscribers' and public telephone lines would be £97,833, this sum including an amount for contingencies of £8,696 (being 10 per cent. on the estimated cost of construction, which was put at £86,963) and £2,174 for engineers' fees, calculated at 2½ per cent. on the cost of construction. The estimated revenue was put at £27,550—made up of £27,300 from 5,200 instruments at a uniform charge of £5 5s. and £250 from call office and sundry receipts. Thus, the estimated gross revenue was in the ratio of 28 per cent. on the total estimated capital expenditure (including 10 per cent. for contingencies). The recently issued accounts of the Glasgow Corporation Telephone Department show that up to May 31st, 1904, the total capital expenditure was £331,892. This amount includes the stores, tools and sundry plant; but as the original estimate included 10 per cent. on the cost of construction for contingencies, it is fair to compare the total capital expenditure at the present time with the total estimated capital expenditure. The total revenue for the year ending May 31st, 1904, was £49,639. This is slightly under 15 per cent. on the total capital expenditure. The ctual expenditure is therefore bringing in a gross revenue pf a little more than half of the estimated gross revenue in proportion to the capital expenditure. There has been no erious modification of the rates proposed in the original scheme, as the £5 5s. rate for unlimited service has been adhered to, and the fact that the number of message-rate lines is only 3½ per cent. of the total subscribers' lines shows that the reduced receipt from message rate subscribers is a negligible factor in explaining the reduced ratio of gross revenue to capital expenditure in actual practice, as compared with the estimates. The true explanation of the fact that the gross revenue in proportion to capital expenditure is only one-half of the percentage estimated is that the plant provided is far greater, in proportion to working subscribers' lines, than that provided for in the estimates.

The statistics relating to the plant which are attached to the report of the Glasgow Telephone Committee, show that the system contained 11,405 instruments on May 31st, 1904. The total subscribers' lines, however, are only 9,000, the remaining 2,400 instruments being inside and outside extension, private line and sundry instruments. Of inside extension instruments there are 1,081. The capital cost of this class of instrument is merely the cost of the instrument and switch, *plus* the cost of the inside wiring and work of installation. The average capital cost of such an instrument is about £3 10s. In the accompanying curves the inside extension instruments have been disregarded, as their total capital cost is so small that it would naturally come under the item for contingencies which was so liberally allowed for in the original estimate. The three curves show respectively a comparison of the number of lines estimated for and the number actually served with the estimated and actual capital expenditure, and with the estimated and actual plant. In each of the curves the full line marked A is the total number of subscribers' and public telephone lines, and the broken line marked A′ is the total number of lines of all classes, including outside extension, private and sundry lines. The lines shown by the difference between A and A′ have no relation with the switchboard plant, as the greater proportion of them are merely extensions of the lines shown by A, and the rest are private lines entirely disassociated from the exchange plant. The outside extension lines account for a certain amount of line plant, but relatively not for very much, as they are usually overhead extensions from the main

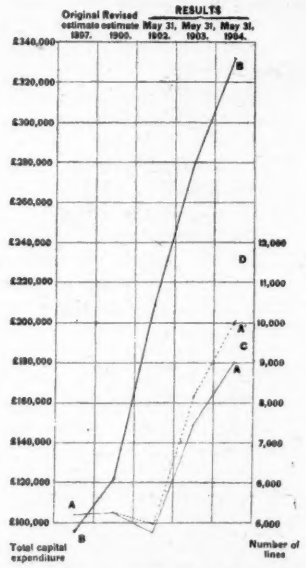


FIG. 1.—ESTIMATED AND ACTUAL CAPITAL EXPENDITURE.—A, Subscribers' and public telephone lines; A′, Total lines of all classes, including outside extension, private and sundry lines; B, Capital expenditure; C, Capital expenditure for 10,000 lines on basis of 1897 estimate; D, Capital expenditure for 10,000 lines on basis of 1900 estimate.

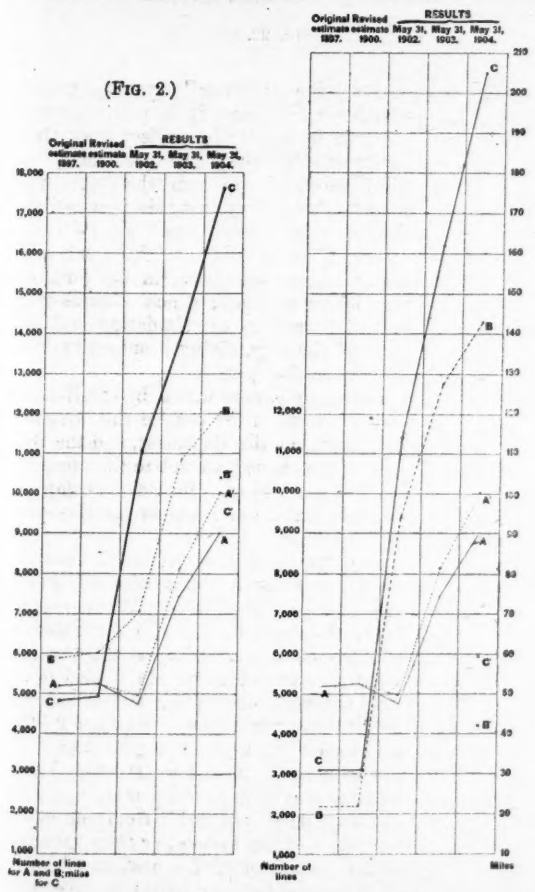
station to the extension station, and average a very short distance. In showing them on the curves as adding to the total number of lines, a liberal concession is made in any comparison with the original estimates, as these estimates dealt only with main subscribers' lines.

Curve No. 1 shows the estimated and actual capital expenditure. Curve No. 2 shows the line and switchboard plant, and curve No. 3 shows the trenching and cable. In each case there will be seen a startling difference between the estimated amount of capital or plant in ratio to subscribers' lines and the actual amount of capital or plant. To make still more clear the difference between the actual results and the estimates, on each curve points have been plotted showing the height which the curve for capital expenditure and plant would have reached if the estimate had been borne out by the actual results.

In curve No. 1, relating to capital expenditure, it is seen that the original estimate was £97,800 for 5,200 lines, and the revised estimate was £121,000 for 5,250 lines. The difference between the revised estimate of 1900 and the original estimate of 1897 is accounted for by the fact that the 1900 estimate was to provide, in addition to 5,250 completed lines at £19 1s. each, 5,250 spare partially completed lines at £4 each, which brought the total capital up to the point shown. The main estimate was also slightly increased, making the average estimated capital expenditure per subscriber's line £23 1s., in place of £18 16s., as in the 1897 estimate. The point

marked C on the curve shows where the total capital expenditure would have arrived for 10,000 working lines if the original estimate had held good. The point marked D shows where the total capital expenditure would have arrived, with 10,000 working lines in service, if the revised estimate of 1900 had held good. The difference between C and B, the actual capital expenditure, is £143,000. The difference between D and B is £101,000. An interesting point about this curve is that the scale for pounds sterling is 20 times the scale for number of lines. If the original theory on which the Glasgow system was based, namely, that the capital cost per working subscriber would average about £20, had held good, the curve for capital expenditure should have closely followed the curve for number of working lines. The manner in which the curve for capital expenditure has separated itself from the curve for number of lines is sufficiently apparent not to need remark.

FIG. 2.—ESTIMATED AND ACTUAL SWITCHBOARD CAPACITY AND CABLE-PAIR MILEAGE.—A and A′, same as in fig. 1; B, Switchboard capacity; C, Cable-pair mileage; B′, Switchboard capacity for 10,000 lines on basis of estimates; C′, Cable-pair mileage for 10,000 lines on basis of estimates.



(FIG. 2.)

(FIG. 3.)

FIG. 3.—ESTIMATED AND ACTUAL CONDUIT AND CABLE PLANT.—A and A′, same as in fig. 1; B, Length of trenching; C, Length of cable; B′, Trenching for 10,000 lines on basis of estimates; C′, Length of cable for 10,000 lines on basis of estimates.

The other two curves show respectively the estimated and actual amount of cable conductor and switchboard capacity in comparison with the number of working lines, and the estimated and actual amount of trenching and cable in comparison with the number of working lines. These curves explain curve No. 1. In each of them points have been shown which indicate where the curve for amount of plant would have arrived if the original estimate of amount of plant required in proportion to working subscribers' lines had held good. On curve No. 2, B′ shows the point where the switchboard capacity should be if the original estimate of switchboard capacity in proportion to working lines had been correct. C′ shows the point which the curve for cable conductor mileage would have reached if the original estimate of cable conductor mileage required in proportion to working lines had held good. Similarly, on curve No. 3, B′ indicates the total length of trenching which, according to the estimate, should have been required for 10,000 working lines, and C′ the amount of cable which, according to the estimate, should have been required for 10,000 working lines. In each of these curves, with the exception of the switchboard capacity, the difference between the estimated and the actual plant in proportion to working lines is startling, and sufficiently explains the great difference between the estimated and actual capital expenditure.

The curves 2 and 3 throw a side-light on an interesting point in connection with the original estimates. There has been a tendency of late to throw overboard the original estimate, and to declare that it was not intended to be a working estimate at all. As a matter of fact, it was backed by tenders from a number of contractors, and was put forward, not merely as an estimate, but as a statement of ascertained cost. The curves show clearly that in the revised estimate of 1900 hardly any revision was made of the original estimate, as in the two cases the amount of plant provided for is almost identical.

Taken as a whole, the curves show plainly that the original estimates were based on entirely inadequate notions of the cost of a telephone system to serve the Glasgow telephone area. I need hardly say that in all cases the figures from which the curves are plotted are taken from the printed and published estimates and official accounts and statistics of the Glasgow Corporation telephone department.

THE COLLIERY EXHIBITION.

(*Continued from page* 165.)

Haulage Gear.—A large number of photographs of mining equipments were shown at MESSRS. SCOTT AND MOUNTAIN'S stand, among the most interesting being three main and tail hauling gears installed at the Tredegar Pit. This gear (fig. 21), is driven by a 55-H.P. induction motor, and it is well known that the starting of such motors under load involves very large currents of low power factor, producing great fluctuations in the pressure. In order to avoid this, the drums are provided with "Hall" clutches, which enable the driver to start and stop with ease whilst keeping the motor running at a constant speed. These clutches consist of an iron band lined with wood segments, anchored to the sides of the drums, and are operated by contracting on to the driving rim which is keyed to the drum shaft. The gears are mounted on a steel girder frame of channel section.

MESSRS. DAVIS & SONS, of Derby, showed a portable single drum, helical geared, driven by a 10-H.P. 500-volt motor, the drum being geared up to the motor by a raw-hide pinion and cut-steel spur wheel.

On the stand of THE WESTINGHOUSE COMPANY, at which a variety of plant was shown, a 20-H.P. electrically driven haulage gear was exhibited, as shown in our illustration (fig. 22). The motor is of the three-phase induction type, and, as seen from the illustration, drives the haulage drum through cut spur gearing, and is capable of exerting a pull of 7½ cwt. on the rope at a speed of 600 ft. per minute. The haulage drum runs loosely on the shaft, to which it can be connected by means of a double-coned friction clutch, which is put into action by means of a screw and lever, which causes the drum to slide sideways on the shaft. The thrust of the cone clutches is taken up on a gun-metal thrust collar. The whole of the gear and the motor are mounted on a stiff frame constructed of boiler plate suitably stiffened with angle-irons.

Electrical Winding Gear.—Electrical winding has not, as yet, been adopted on any large scale in England, although for short lifts it is becoming more general. Fig. 23 illustrates a 20-H.P. electrical winding gear, made by MESSRS. SCOTT & MOUNTAIN. As will be seen from the illustration, the motor is geared up to a short countershaft by cut-spur

gearing, this shaft being then geared up to the winding-drum. On the right hand side of the illustration is shown the starting and reversing switch, and on the left side an automatic magnetic brake. The conditions obtaining in main shafts are very different to those in short auxiliary shafts or staples. In the case of a main winding gear it is possible to use an engine of the very best and most efficient type, coupled direct on to the winding drum, and as the engine is near the boilers, the losses in transmission are reduced to a minimum. Owing to the fact, however, that the engine must be started and stopped for each lift, the low average power factor and condensation losses bring the steam consumption per B.H.P.-hr. on the drum shaft to a fairly high figure, ranging from 40 to as high as 120 lbs. In addition to the intermittency of the load, the maximum power exerted is at some portions of the lift from two to four times the average load. The engine must, of course, be large enough to deal with this maximum, and is, therefore, for a great portion of its time, working on an uneconomical load. For instance, to lift 1,000 tons in an 8 hours' shift up a pit shaft 600 yds. deep, the actual average H.P. on the rope is less than 260. But, owing to the intermittency of the load and the quick acceleration necessary, an engine for this work would need to develop about 1,800 H.P. To merely

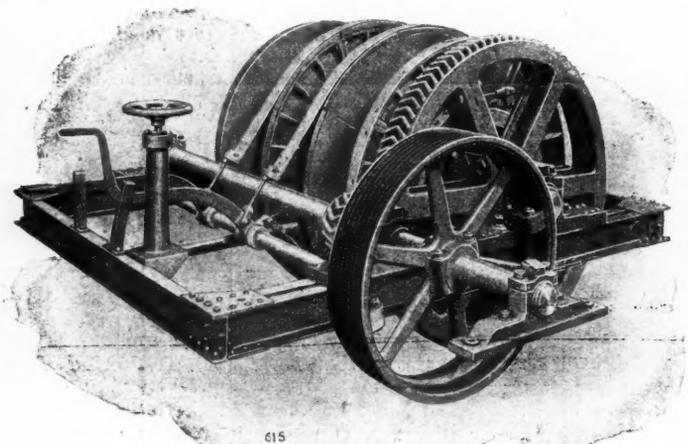


Fig. 21.

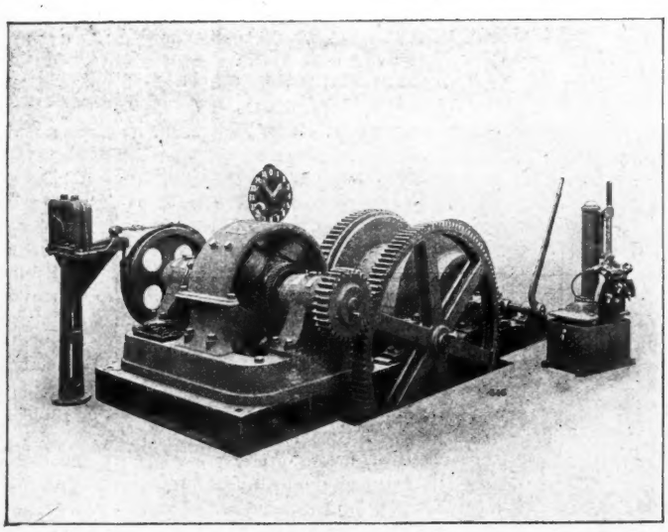


Fig. 23.

replace the engine by a motor of the same power working under the same conditions would offer very little, if any, advantage over steam driving. In order then to show any improvement by the adoption of electrical methods, it is necessary to devise means radically different from those adopted in driving any ordinary class of machinery. A system which has been adopted with marked success on the Continent by Messrs. Siemens & Halske, the A.E.G. Co.,

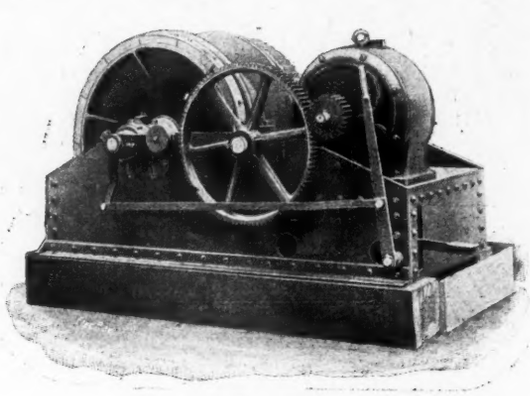


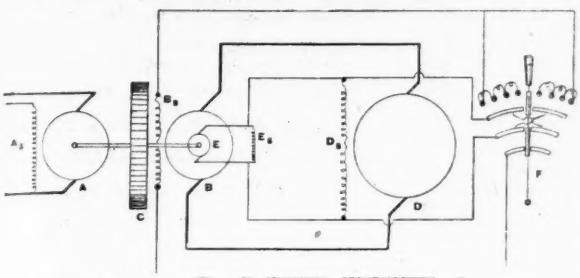
Fig. 22.

and others, known as the "Ilgner" system, possesses features of considerable merit; and it is pretty generally admitted by experts in colliery work that it has practically solved the problem of electrical winding. To sum the system up in a few words is to say that this is a modification of the well-known Ward-Leonard method of control with which is embodied a mechanical storage system in the form of a very heavy fly-wheel, which absorbs energy during the periods of retardation and stopping of the cage, giving it out again during the acceleration period.

Photographs were shown by the Electrical Co., of work carried out on this system by the A.E.G. on the Continent, and the Bruce Peebles Co. issued an interesting pamphlet on the same subject. Both these companies, we understand, are licensees for the system in this country.

A diagram of the system is shown in fig. 24, in which A and B represent a motor and generator coupled together in line to a heavy fly-wheel, C, which is hung between the two machines. D represents the main winding motor, which runs in a field of full and constant excitation, the shunt field circuit being energised by the exciter E, which is coupled to the motor-generator. The combination A B and C, therefore, represents a heavily fly-wheeled motor-generator, and may be driven either from the generating plant at the colliery, or from the supply mains. The motor, of course, may be either of the continuous or polyphase type, but B and D are continuous-current machines. Assume now the motor-generator to be running at its full speed, the generator giving it maximum voltage and the cage ascending the pit shaft. To stop the winding motor D, the excitation of the generator B is reduced, just as in the case of the Ward-Leonard equipment. The cage, however, has acquired considerable momentum, and as soon as the dynamo voltage is reduced, the winding motor acts as a generator, putting current back into the motor-generator, and so storing up a large portion of the energy of retardation and stopping in the fly-wheel, which thus acts as a regenerative brake. This stored energy of braking is again given out to the winding motor during the next wind. As the fly-wheel stores energy both during the period of retardation and whilst the cage is at rest, the energy taken from the line is very uniform, causing quite a negligible fluctuation on the power mains; whereas, if the winding motor itself were connected directly to the power mains, it would be necessary to run a separate generator to feed it owing to

the intermittency of the load. The evolution and perfection of the Ilgner system are due, we believe, to some such trouble as this having been experienced. The method of control is very simple and practically automatic. Stops are provided which, in the event of the cage overrunning, apply a compressed air brake to the drum and open the main circuit. It is usual in this system to employ an electrically-driven



A, Motor; B, Generator; C, Fly-wheel; D, Winding motor; E, Exciter; F, Reversing regulator in generator field; S, Shunt field winding.

FIG. 24.—DIAGRAM OF "ILGNER" SYSTEM OF WINDING.

compressor to work the compressed air brake, which can either be worked manually or by the knock-off stops mentioned above. The whole of the actions are automatic, including the weakening of the generator field, and the application of the brakes, so the system is as absolutely safe as it is possible to design anything. The shunt regulator and reversing switch is marked F.

In the event of the current being cut off, there is sufficient energy stored in the fly-wheel alone to bring the cage up the shaft.

As to economy, it is said by the licensees that the cost of an electrical winding machine complete is about 25 per cent. more than that of a steam winding gear of equal capacity, whereas the saving far outweighs the additional cost. The size of motor-generator to do the work of an 1,800-H.P. winding machine would be about 450 H.P. According to data given by Messrs. Bruce Peebles & Co., at the Merklinde Pit, Westphalia, a winding motor of 1,200 H.P. maximum is used, the output of the pit being from 1,200 to 1,500 tons a day from a depth of 360 yards. The speed is 33 ft. per second, the time of acceleration from rest to full speed is 10 sec., and of retardation from full speed to rest, 4 sec. The total horse-power used in the colliery is 1,000, of which 700 H.P. is running continuously, driving compressors, fans, blowers, and screening plant, the balance of 300 H.P. being taken by the winding gear. It is computed that the winding gear takes only 4 tons of coal to lift 1,200 tons a day from a depth of 360 yards, the coal used being of a very poor quality. It is questionable whether or not there is the same need for electrical winding in this country as in Germany and other parts of the Continent, as the ordinary speeds of steam winding on the Continent are very much lower than here. The advantages of increased speed and output due to electric driving do not, therefore, play so prominent a part with us, and economy of fuel is not always an item of paramount importance in a colliery. There are, of course, the other advantages, inherent to electrical driving, of adaptability, ease of control, and safety, which are frequently of greater importance than considerations of fuel economy.

(To be concluded.)

THE ELECTRICAL ENGINEER AND THE STEAM ROAD.

By HOWARD S. KNOWLTON.

ONE of the most important results of any forward step in applied science is the increase in responsibility and duty which is laid upon the operating engineer. In fact, this increase is often large enough to bring about the creation of new positions and to open up specialised fields of work previously unexploited. Through the employment of large numbers of skilled and unskilled workmen, almost every advance in engineering science proves to be a blessing to the industrial world.

An interesting example of the foregoing is found in the application of electricity to steam railways—a work which is just beginning to be done on a large scale in both America and England. For a long time the steam railway has utilised electricity for telegraphic purposes, and in recent years the electric light and stationary motor have gradually been finding useful places in the stations, cars, and repair shops, while the telephone has crept into favour for the transaction of general business, even if it has not secured a very firm foothold in train despatching. It is only very recently that important applications of electricity as a motive power have attracted the attention of steam railway experts in projects like the electrical equipment of the Liverpool and Southport branch of the Lancashire and Yorkshire Railway in England, and the elimination of the steam locomotive in the New York terminal service of the Pennsylvania and New York Central and Hudson River systems in the United States. At this time, therefore, it seems profitable to make a few comments upon the coming status of the electrical engineer in railroad service.

In the days when the only use of electricity on steam roads was for telegraphing purposes, the electrical engineer, as such, had a very limited round of duties. As long as the telegraph lines and instruments worked properly, the "superintendent of telegraph," or whatever his title was, had little to worry about as far as the material side of his work was concerned. With the advent of improved systems of block and interlocking signals, however, an enormous increase in responsibility was laid upon the man in charge of communication, until the modern signal engineer came to the front, as a specialist of the most pronounced type. The extension of automatic signalling on railroads and the multiplication of manually-operated signal plants or towers has now been carried so far, that the signal engineer of a steam road to-day stands foremost among the important subordinate employés of the system. The responsibility of his work is great, affecting the safety of life and property over a wide territory, and it cannot be said that a compensation of from £400 to £600 a year is a fair equivalent for the heavy burdens which the office imposes, judging from the American standpoint of the writer. The complication of even the best modern electric, mechanical or electro-pneumatic signalling apparatus requires expert knowledge and ability for the proper administration of the equipment over a large system of railway; it requires a grasp of the principles of handling traffic, the construction of time-tables to a degree, and a facility in handling men which ought to command an adequate reward.

From a specialist in communication the railroad electrical engineer has in many cases become a "general practitioner" through the applications of electricity to power and lighting systems. He has retained his control of the signal department, but leaving the detailed work of communication to his foremen or assistants, he has turned to the electrical equipment of the machine shops; the installation of power plants after he has designed and planned their working arrangements; the lighting of stations, warehouses, shops, roundhouses, and cars; and, finally, to the great question of electric motive power for the rolling stock itself. It is evident that he has not "stood still" in his profession.

The present work of the electrical engineer who is employed by the typical steam road of to-day may be summed up somewhat as follows, bearing in mind that local circumstances have a good deal to do in defining his exact duties:—He exercises general supervision over all electrical matters, including lighting and power circuits, generators, motors, arc and incandescent lamps, and all other electrical machinery and apparatus in use upon the railway. The signal and interlocking system is either under his special direction, or indirectly in his care through the administration of a subordinate signal engineer. The electrical engineer prepares standard and special plans as required, with necessary estimates, and it is his duty to supervise the construction, operation, and maintenance of electric installations and circuits in order to ensure compliance with the plans, rules, and specifications relating to them. There is

no doubt that such an official has little time to allow the grass to grow under his feet.

Still more extended duties and opportunities confront the railroad electrical engineer of the immediate future. If he is to hold his place as an employé of highest importance in the subordinate ranks, he must familiarise himself with many new problems. In direct proportion to his knowledge and scientific methods will be his efficiency. Power stations will be larger than anything steam railroad service has yet seen; opportunities for economical design and operation of generating plants, transmission systems and sub-stations will constantly arise; the third rail and the overhead trolley will claim his attention; acceleration curves of railway motors, and load curves of multiple unit trains will visit his nightly dreams, and new schedules and tests dependent upon electric locomotives will lie upon his desk during office hours. More important than anything save safety, the ever-pressing problems of economical operation will command his attention, and the reduction of waste of all kinds will be his hobby. Fortunately, the thorough discussion of these problems by the technical Press is at the command of the railway engineer, and the experience of the great manufacturing companies is his also. If the steam railway which adopts electric motive power gives its electrical engineer a free hand, and the necessary assistants, the results will certainly justify the expense, and be creditable alike to the engineering profession and the transportation world.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

15,962. "Improvements in incandescent electric lamps." M. Sommer. July 18th.

15,942. "Improvements in alternating current electric meters." Union Electricitats-Gesellschaft. July 18th. (Date applied for under Patents Act, 1901, July 18th, 1903, being date of application in Germany.) (Complete.)

15,952. "An electrode for electrical accumulators." K. L Berg. July 18th. (Date applied for under Patents Act, 1901, July 18th, 1903, being date of application in Sweden.) (Complete.)

16,026. "Improvements in vapour electric apparatus." E. A. Carolan. (The General Electric Co) July 19th.

16,038. "Improved telephone system." B. Brander. July 20th.

16,059. "Improvements in apparatus for the generation of electricity, primarily designed for the electric lighting of trains." T. W. S. Hutchins. July 20th.

16,063. "Improvements in connection with electric safety fuses." J. J. Smith. July 20th.

16,108. "Improvements in alternating current electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 20th.

16,109. "Improvements in reverse electric current switches or circuit-breakers." The British Thomson-Houston Co., Ltd. (The General Electric Co. United States). July 20th.

16,110. "Improvements in and relating to electro-magnetic mechanism." The British Thomson-Houston Co., Ltd. (The General Electric Co.) July 20th.

16,155. "An improved method of economising space over the third or 'live rail' on electric railways." H. Curwen. July 21st.

16,161. "An improved electric candle nozzle." F. Thomas. July 21st.

16,166. "Improvements in surface-contact systems for electric tramways and the like. T. M. Trumble and J. P. Trumble. July 21st.

16,171. "A shield or guard for the prevention of injury to workmen and others by accidental contact with exposed 'live' rails or current distributors on electric railroads and the like." J. T. McCoy. July 21st.

16,179. "Improvements in electrical transformers." J. S. Peck and C. Le Geyt Fortescue. (Date applied for under Patents Act, 1901, August 8th, 1903, being date of application in United States.) July 21st. (Complete.)

16,241. "Improvements in or connected with electric arc lamps." J. Brockie. July 22nd.

16,242. "Improvements in electric lights." H. Beck. (Date applied for under Patents Act, 1901, July 24th, 1903, being date of application in Germany.) July 22nd. (Complete.)

16,257. "Improvements in systems of electrical distribution." E. Weintraub. (Date applied for under Patents Act, 1901, July 23rd, 1903, being date of application in United States.) July 22nd. (Complete.)

16,258. "Improvements in transforming the energy of electric currents." E. Weintraub. (Date applied for under Patents Act, 1901, July 23rd, 1903, being date of application in United States.) July 22nd. (Complete.)

16,260. "Improvements in electrical controllers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 22nd.

16,261. "Improvements in apparatus for electrically-heating liquids." The British Thomson-Houston Co, Ltd. (The General Electric Co., United States.) July 22nd.

16,267. "Deposition of zinc or other metals by means of electricity." F. W. Gauntlett. July 22nd.

16,311. "Improvements in electrical signalling apparatus for railways." W. Andrews, F. Allcock, and W. Keyworth. July 23rd.

16,312. "Improvements in or relating to the detection of electrical oscillations." L. H. Walter and J. A. Ewing. July 23rd.

16,324. "Improvements in galvanic elements or batteries." S. G. Visker and P. C. Kaz. July 23rd.

16,326. "Improved apparatus for use in the teaching of electric telegraphic and other signalling by means of the Morse or other similar codes." W. McDonald. July 23rd.

16,346. "Improvements in or relating to selective electric switches." I. B. Birnbaum and F. G. Bell. July 23rd.

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Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Circuit Breaking Fuse. H. L. Dixon. 8,883. April 20th.

Contact-Makers for Electrical Recording Turnstiles. A. March. 9,088. April 22nd.

Metal Clamp Applicable for the Supporting Standards and Brackets of Overhead Electric Wires and other Purposes. C. Naylor and J. Naylor. 9,173. April 23rd.

Electrically Heated Hand Tools or Implements. R. Haynes. 9,264. April 24th.

Alternating Current Meter. A. M. Clark. (Hartmann & Braun, Germany.) 9,311. April 24th.

Electric Lifts. J. S. Stevens, C. G. Major, E. C. Stevens, and P. H. Stevens. 9,882. April 25th.

Transmitting Electric Current to Tramcars and the like. A. Hirst and Son, Ltd., and H. Hirst. 9,649. April 29th.

Electric Connecting Devices Applicable to Lamp-holders, Wall Plugs, and the like. C. L. R. E. Manges. 9,728. April 29th.

Emergency Brakes. E A. Carolan. (General Electric Co.) 9,806. April 30th.

Devices for Detecting High Voltage in Electrical Circuits and Apparatus. E. A. Carolan. (General Electric Co.) 9,809. April 30th.

Methods of Winding Dynamo Electric Machines. E. A. Carolan. (General Electric Co.) 9,811. April 30th.

Electric Lamps. W. Boehm. 9,832. April 30th.

Electrical Water Resisters. H. McDonald. (Communicated.) 10,160. May 5th.

Purifying Air and Generating Ozone by Electricity. C. Wokes and F. H. Street. 10,251. May 6th.

Electrically Lighting Miners' Safety Lamps. W. Sedgwick and J. F. Smith. 10,382. May 7th.

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Electric Advertising Devices. R. D. Lampson. 10,702. May 11th.

Electric Heaters and Stoves. H. Binko. 10,772. May 12th.

Protective and Advertising Device for Telephones and the like. J. Effertz. 10,957. May 13th.

Electric Crucible Furnace. A. Reynolds. 11,000. May 14th.

Electric Crucible Furnace. A. Reynolds. 11,001. May 14th.

Method of Melting Steel and the like in Electric Resistance Furnaces. A. Reynolds. 11,002. May 14th.

Electric Arc Lamps. Guest, Keen, & Nettlefolds, Ltd., and C. Wakeman jun. 11,088. May 15th.

Manufacture of Electrodes. C. Roderbourg. 11,276. May 18th.

Control of Electric Motors. Johnson-Lundell Electric Traction Co., Ltd. 11,304. May 18th.

Switches for Electric Batteries. A. J. Boult. (The Electric Storage Battery Co., United States.) 11,323. May 18th.

Regulators for Alternating Series Arc Light Systems. H. H. Lake. (General Incandescent Arc Light Co., United States.) 11,418. May 19th.

Arc Light Electrodes. O. Vogel. 11,442. May 19th.

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Ozoniser of High Frequency Adapted to be Directly Connected to a Dynamo. M. Otto. 12,193. May 28th.

Process and Apparatus for the Production of Metals of the Alkali Group by Electrolysis. E. A. Ashcroft. 12,377. May 30th.

Manufacture of Electric Cables. W. Dieselhorst and A. W. Martin. 12,526. June 2nd.

Exciting and Regulating Alternating Motors and Alternators having Collectors. A. Blondel. 13,647. June 17th. (Date applied for under Patents Act, 1901, June 17th, 1902, being date of application in Belgium.)

Electric Apparatus for Therapeutic Use. F. C. Fisher. 13,937. June 23rd.

Electric Controllers. A. Sundh. 14,551. June 30th.

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Electric Incandescent Lamps. P. Kleber. 14,575. June 30th.

Electric Switches. G. W. Somerville and Howard and Bullough, Ltd. 10,646. May 11th.

Positive Electrodes for Secondary Batteries. C. Roderbourg. 1,088. January 15th.

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Electric Railway and Tramway Systems. A. T. Cooper. 9,712. April 29th.

Insulated Joints for the Rail Sections of Electric Railways. S. E. Page. 10,080. May 4th.

Electrical Fuses. Siemens Bros. & Co., and H. Berry. 11,629. May 21st.

Installations for Starting and Working a Number of Independent Electric Motors. Siemens Bros. & Co., Ltd. (Siemens and Halske A. G.) 12,983. June 9th.

Exhausting and Sealing Incandescent Electric Lamps. E. A. Carolan. (General Electric Co., United States.) 9,590. April 28th.

System of Contact Breaker for the Primary Circuit of Induction Coils. R. Chauvin and R. Arnoux. 4,989. February 25th.

Apparatus for Transforming Reciprocating into Continuous Rotary Motion. P. E. Bastiou. 6,859. March 24th.

Electrical Connections. F. W. Lanchester. 7 064. March 27th.

Alternating Electric Current Motors. E. A. Carolan. (The General Electric Co., United States.) 7,189. March 27th.

Method of Regulation for Altepnate Current Machines. G. Winter and F. Eichberg. 7,293. March 28th.

Electric Switches. C. H. Davies. 7,377. March 30th.

Electric Motor-Control Systems. E. A. Carolan. (General Electric Co., United States.) 7,462. March 31st.

Electrolytic Meters. E. A. Carolan. (General Electric Co., United States.) 7,587. April 1st.

Electric Railways for National or International Communication. R. C. Sayer. 7,829. April 4th.

Automatic Electric Signalling Apparatus for Tramways. L. E. Harvey, E. P. B. Estler, P. Traugott, J. Estler, and H. P. C. Estler. 8,112. April 8th.

Means for Automatically Regulating Electric Circuits. H. Leitner. 8,812. April 18th.

Control of Electrically Propelled Vehicles. J. S. Raworth. 10,723. May 11th.

Trolleys of Electrically Propelled Vehicles. P. Fielding. 11,242. May 18th.

Electrical Measuring Instruments. Eversbed & Vignoles, Ltd., and S. Eversbed. 11,509. May 20 h.